Clandestine Photography

Basic to Advanced Daytime and Nighttime Manual Surveillance Photography Techniques

For Military Special Operations Forces, Law Enforcement, Intelligence Agencies and Investigators

Raymond P. Siljander

Lance W. Juusola

CLANDESTINE PHOTOGRAPHY

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Basic to Advanced Daytime and Nighttime Manual Surveillance Photography Techniques

For Military Special Operations Forces, Law Enforcement, Intelligence Agencies and Investigators

By

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and

LANCE W. JUUSOLA

Forewords by

Stephen M. Hennessy, ED.D.

and

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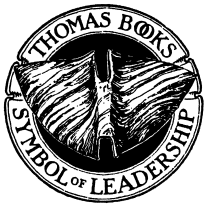

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To Mark S. Knapp

FOREWORD

In my forty years in federal, state, and local law enforcement, I have experienced and worked with numerous types of surveillance equipment and watched as pinhole cameras and tracking bugs gave way to more sophisticated means of finding out what the bad guys were up to. I can remember the frustration of trying to accomplish what the equipment of the time wouldn't or couldn't do. As a police executive, I also remember working with the various technicians on limited budgets trying to get the best equipment that was possible to do the job that sometime seemed impossible.

I have read many manuals and books over the years on how to do what with various types of photographic surveillance; however, I have never seen nor read a more comprehensive text on clandestine photography than that just written by Raymond Siljander and Lance Juusola.

This is a text specific to clandestine photography and is appropriate for anyone in law enforcement, intelligence agencies, military special operations, and private investigators involved in clandestine photography. It is written and well illustrated in an easy to understand style for all photographers regardless of skill level and kind of equipment used. The text demonstrates short-range as well as ultra-long-range methods of photography and presents advanced night vision methods and the configuration of exceptionally fast optical systems using commercially available optical components.

This easily understood text takes the reader through conventional as well as sophisticated, clandestine methods of photography. It walks the reader through the use of all types of photographic equipment ranging from typical off-the-shelf to expensive, high-tech pieces. The authors also present ways to significantly minimize equipment costs as one develops expertise.

The authors walk the reader through the various techniques with many illustrations to make the concepts easy to understand and visualize. I highly recommend this book to anyone in the public or private sector involved in surveillance photography.

Stephen M. Hennessy, Ed.D.
Associate Professor (ret.)
St. Cloud State University, St Cloud, Minnesota

FOREWORD

As a young FBI agent, I spent many hours in the back of a cramped surveillance van taking what seemed to be innumerable photographs of all sorts of illicit activity: drug deals, property crime stings, corrupt politicians soliciting bribes from undercover agents, etc. I understood why the veteran agents got the young ones to do the job (if you have any questions, spend a few quality hours in the back of your mini-van on a summer day when you cannot use the air-conditioning). What I did not understand was why they placed such importance on a few photographs, especially when they already had recorded conversations and could depend upon the testimony of trusted agents. My breakthrough came when I finally had to present evidence in court. A relatively recent proverb, often incorrectly attributed to Confucius, holds that a picture is worth a thousand words; with juries, it is more like ten thousand. Or a million. There is nothing to better explain a complex case than photographic evidence; a defendant can deny his involvement in a crime until the next millennium or a skilled defense attorney can attempt to confuse a jury, but a picture is, well, worth a thousand words.

It is worth noting that the world today is a far more complex place than it was when I was spending my days in the back of a surveillance van. We face challenges and threats from myriad quarters, never dreamed of years ago. Clandestine photography is no longer merely the province of law enforcement; rather, intelligence agents and increasingly soldiers, marines, airmen, and sailors have to master its intricacies to deal with the complex challenges of terrorism and insurgencies. As well, the state-of-the-art of clandestine photography has changed, thanks to exponential leaps in technology. Today, third-generation night vision devices allow us to take credible photographs at a distance of nearly a mile. This has required us to alter our strategies and tactics to ensure that we maximize the use of this incredible technology.

Raymond Siljander and Lance Juusola have done an excellent job cataloging these changes and providing a manual that anyone can use to enhance their skills. They discuss the challenges, and the solutions, for producing high quality photographs under inhospitable and often hostile conditions. By the

time a reader has finished with this volume, he or she will be well on the way to developing a mastery of clandestine photography. As Raymond and Lance note, "it is unlikely that the adversary will possess a manual clandestine photography capability exceeding what this book presents." Given the unparalleled examination of the subject presented herein, I have no doubt that they are correct.

Indeed, I only wish this book had been available in my younger days; it likely would not have made my time in the back of the van any more enjoyable, but it would have made it much more productive.

Carl J. Jensen III, Ph.D.
Director, Center for Intelligence and Security Studies
The University of Mississippi
Supervisory Special Agent, Federal Bureau of Investigation (retired)

PREFACE

The topic of this book is manual clandestine photography, commonly referred to as surveillance photography. This application of photography is challenging because of the diverse, adverse, often hostile, and active countersurveillance environments in which photographing frequently occurs. Often distances are extreme and environmental conditions are unfavorable. This book presents myriad methods for secretly photographing people and property under diverse and difficult conditions.

This book presents conventional clandestine photography methods and advanced hybrid techniques. Readers will discover innovative applications of combinations of old and new photographic-related technologies, some combined in unexpected ways that produce surprising results. This book features high-tech equipment and it identifies ways to minimize equipment costs.

It provides the most comprehensive night-vision photography discourse available, presenting conventional and advanced methods. Readers will discover esoteric techniques for photographically recording recognizable images of human subjects and legible vehicle number plates from distances of 1.61 kilometers (1 mile) or more using image intensifier night vision devices. Readers will also discover methods for recording comparable detail during daylight hours from distances exceeding 1.77 kilometers (1.10 mile). The authors developed the ultra-long-range, night vision photography methods presented in the text and therefore detailed information about the techniques exists only here.

Historically, every morning and evening there was a time that manual clandestine photography was impossible. It was too dark for high ISO available light photography but too light for photography using an image intensifier night vision device. The same was true for many artificially illuminated nighttime environments; the level of illumination precluded either method of photography. The authors developed techniques that permit photographing under all levels of illumination.

The information in this book will benefit government surveillance specialists and those responsible for detecting and thwarting manual clandestine

photography. It is unlikely that an adversary agent will possess a photography capability exceeding what this book presents.

R.P.S.
L.W.J.

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CLANDESTINE PHOTOGRAPHY

Chapter 1

MANUAL CLANDESTINE PHOTOGRAPHY IN THE TWENTY-FIRST CENTURY

> The camera sees more than the eye, so why not make use of it!
> (Edward Henry Weston, 1886–1958)

> In addition to the written logs, still photographs and video footage provide visual documentation of an occurrence and constitute the work product of a surveillance. The mere existence of photographs has resulted in countless jury convictions and guilty pleas being entered, thereby saving prosecutor's offices and law enforcement agencies months of trial preparation, as well as the trial itself. For this reason, investigators should attempt to obtain the highest quality surveillance photographs whenever possible. (Nason, 2004, May, n.p.)

PROLOGUE

The topic of this book is manual clandestine photography, commonly referred to as surveillance photography. When work on this book began, the authors evaluated the state of the craft and identified areas requiring enhanced photographic methods. They felt that elevating the craft was necessary because, today, global circumstances are troubled in ways and to an extent that differ from not many years ago. The result is a need for enhanced field application methods of manual clandestine photography and an increased ability to thwart the photographic efforts of enemy personnel.

Today, more than in the past, law enforcement agencies, intelligence collection agencies, and military special operations forces need the ability to record still photographs and moving video images from extreme distances during daylight hours and at night. They also need the ability to clandestinely photograph and film subjects from as close as a few meters. Circumstances also require that some photographic surveillance operations occur for an extended duration. The latter can require a significant standoff capability to

ensure that the operation remains undetected and to keep the surveillance team safe.

During their assessment of manual clandestine photography tradecraft, the authors identified several areas of importance. Some areas required research and development to enhance photographic potentials, photography using image intensifier night vision devices being one example. The following list identifies the areas of importance and presenting the information here is what makes this book unique. This book is essential reading for anybody practicing manual clandestine photography. It is also essential reading for the people responsible for detecting and thwarting the clandestine photography efforts of an adversary.

- This book presents conventional manual clandestine photography and videography using commercially available cameras and camcorders. In many instances, however, the authors discuss the use of conventional equipment in unconventional ways.
- This book presents ways to do long-range and ultra-long-range photography and videography without investing in extremely expensive photographic equipment. Identifying alternative products and methods was necessary because many agencies operate within the confines of a limited budget. For less cost than most agencies realize, they can do long-range photography and HD videography.
- This book presents methods for recording usable still photographs and moving video images during daylight hours from extreme distances. Consider "extreme distance" to mean 0.80–1.61 kilometers (0.50–1.0 mile) and sometimes farther.
- This book presents methods for clandestinely recording single images and moving video images from very short distances, in some instances from only a couple of meters from the subject or from the far side of a room.
- This book presents low-light photography and videography methods that do not require the use of an image intensifier night vision device.
- This book presents conventional methods of night vision photography and videography.
- This book presents extreme distance night-vision photography and videography methods. Using high quality, third-generation (Gen 3) image intensifier night vision devices, the surveillance specialist can photographically record detail such as recognizable images of human subjects and legible vehicle number plates (license plates) from distances up to and in some instances exceeding 1.609 kilometers (1 mile). That is, under suitable nighttime conditions using appropriate

Figure 1-1a. Extreme distance photography during the day and at night is possible using appropriate equipment and technique. *Upper image:* Ultra-high-magnification night vision photography system. The night vision weapon sight serves as a finder scope, which is essential for the extreme distances the authors present in this book. *Lower image:* Using the electro-optical system in the upper image the surveillance specialist photographed this police officer from a distance of 0.87 kilometer (0.54 mile). Text discusses and illustrates this and other extreme-distance night vision photography methods.

equipment and technique. The authors developed the ultra-long-range, night vision photography methods presented in this book and therefore detailed information about the techniques exists only here (see Figures 1-1a and 1-1b). At the opposite extreme, sometimes the surveillance specialist must photographically record subjects from

Figure 1-1b. Examples of practical electro-optical configurations for long-range night vision photography and videography. Text discusses and illustrates in detail these and other electro-optical configurations.

very close range and this book discusses appropriate methods for accomplishing that (see Figure 1-2).

The greatest accomplishment during the writing of this book was increasing the distance from which night vision photography and videography is possible. The authors increased the standoff distance from a few hundred meters to 1.61 kilometers (1 mile) or more. That is, for recording detail such as recognizable images of human subjects and legible vehicle number plates. This book presents several methods for ultra-long-range night vision photography and videography, some methods intrinsically capable of greater

Figure 1-2. These are single images extracted from a stream of moving video images. Using a concealed high-definition camcorder, the surveillance specialist covertly filmed these individuals from the table closest to the beverage dispenser. Neither these individuals nor anybody else in the restaurant was aware that HD videography was occurring.

distances. In addition, an important accomplishment was finding ways to close the time window on each end of the day when photographing could not occur; it was too dark for high ISO available light photography yet too light to photograph using an image intensifier night vision device. Using the author's methods, there is no time, no illumination level under which photography and HD videography cannot occur.

This book presents many hybrid and unconventional methods of photography. That is because the surveillance specialist must do whatever is necessary to photograph under challenging conditions. Readers who think beyond convention will find the information in this book informative and exciting and will undoubtedly encounter photographic methods and ideas they are unfamiliar with and did not realize were possible.

SCOPE, PLAN, AND PURPOSE OF THE BOOK

The topic of this book is, as stated, manual clandestine photography. Nevertheless, except for being silent about ways to ensure sponsor anonymity, the photographic information in this book is suitable also for covert operations. The target audience of this book is all levels of law enforcement, intelligence collection agencies, military special operations forces, and the Department of Homeland Security. Nonetheless, private investigators will find the information useful and, of necessity, some photographic methods employed by private investigators found their way into this book. The information provided in this book is specific to manual clandestine photography and found in no other single source.

The term *manual photography* as used in this book refers to manually operated photographic equipment whether handheld or mounted to a tripod or some other support system. Additionally, it matters not whether the surveillance specialist operates the camera by touching it directly or by using a remote device. Some people refer to *manual photography* as *handheld photography*. Both terms mean the same thing and appear throughout this book.

Manual clandestine photography is one of the most challenging applications of photography there is. That is because of the diverse, adverse, often hostile, and active countersurveillance environments in which the surveillance specialist records photographic images. Moreover, the subject determines the time and location of photography. Distances are often extreme and atmospheric and lighting conditions are not always appropriate for photography leaving the specialist doing the best he or she can under difficult circumstances. Fortunately, the objective is photographically documenting something of investigative or intelligence importance, not creating an aesthetically pleasing photographic work of art.

This book presents conventional surveillance photography methods using commercially available photographic equipment. Additionally, it explores innovative applications of combinations of old and new photographic related technologies, some technologies combined in unexpected hybrid ways. Some of the hybrid methods warrant further exploration. While the information in this book will benefit government surveillance specialists, it is equally useful for those responsible for security and the detection and thwarting of manual clandestine photography by an adversary. It is unlikely that an adversary will possess a manual clandestine photography capability exceeding what this book presents.

The target audience of this book is diverse and that raised the question of the most appropriate terms to use for generically referring to the practitioners of manual clandestine photography. Private investigators commonly refer to

those specializing in surveillance photography as Surveillance Technicians. In the American law enforcement sector, the term Surveillance Technician refers to those engaged in (1) manned surveillance photography and videography, (2) the clandestine concealing of hidden video cameras, and (3) the installation of electronic surveillance devices (technical surveillance). The United Kingdom's Security Service (MI5) uses the term Mobile Surveillance Officer to identify the practitioners of physical surveillance; their responsibilities include photography. The Federal Bureau of Investigation (FBI) uses the term Surveillance Specialist to identify the practitioners of physical surveillance.

The FBI website explains the responsibilities of surveillance specialists as follows: "Surveillance Specialists conduct fixed surveillance duties that support Foreign Counterintelligence and/or Counterterrorism investigations, and gather intelligence information of investigative interest. Surveillance Specialists utilize various communications, photographic, and technical equipment during surveillance operations" (Federal Bureau of Investigation, n.d., n.p., *FBI Careers in Investigative Support and Surveillance*).

Because this book addresses manual photography as applied during physical surveillance operations, and because diverse but similar terms identify the practitioners, the authors refer to *anybody* engaged in manual clandestine photography as a clandestine photographer, surveillance specialist, or simply specialist. The three terms appear throughout the book with context determining the choice of term.

The easy-to-read and well-illustrated style of this book is necessary because of the complex nature of this topic. The surveillance specialist must be capable of recording usable photographic images from distances and under atmospheric and lighting conditions unfavorable for photography, and do so without detection by the subject. That requires being a skilled photographer and skilled in clandestine arts. The surveillance specialist must infiltrate, record photographic images, and then exfiltrate without detection and without leaving behind evidence of having been in the area.

The increasingly troubled global situation and changing circumstances have increased the need for human intelligence, effective counterintelligence, and innovative and proactive investigative methods. That in turn created a need for enhanced manual clandestine photography methods and the need for security personnel to understand manual clandestine photography even if they do not practice it.

Today, more than ever before, the United States government must do what is necessary to remain in the forefront relative to investigative methods and clandestine tradecraft. The term tradecraft as used here refers to the methods used in clandestine operations such as some phases of criminal investigations, criminal and political intelligence collection, special operations

forces reconnaissance, manual clandestine photography, and it refers to the modus operandi of espionage.

Interesting note: At the end of June 2010, the U.S. Federal Bureau of Investigation (FBI) arrested eleven people suspected of being Russian spies. Significantly, the alleged spy ring used Cold War[1] methods. The case reveals that although with time the tools of espionage get better clandestine tradecraft changes very little. The Old Testament of the Christian Bible reveals that spies operated much the same centuries ago as they do today. The difference is, today's spies have motor vehicles, aircraft, cameras, radios, and computers. Then, as now, females are essential in the world of espionage (and investigation) because it is a people business. In the book, *Introduction to Business and Industrial Security and Loss Control,* the author visits this important issue.[2]

To meet diverse reader needs, this book presents basic, advanced, and specialized hybrid photographic techniques specific to criminal investigation, intelligence collection, and military tactical operations. It presents information in the direct and easy to understand manner necessary to support hands-on training and self-directed study. This book is a well illustrated straightforward "how-to-do-it" instruction manual.

This book takes the reader far beyond the boundaries of conventional terrestrial photography by consolidating varied disciplines and by providing information that is new, innovative, and unorthodox. Most photography information is scattered among diverse sources with nothing to integrate it with related technologies in a hybrid manner and neither is it manual clandestine photography specific. This book brings myriad information to bear in one source.

In this book, the reader will discover photographic potentials that most professional photographers and government personnel were unaware were possible. As for night vision photography, the reader will discover hybrid methods and ultra-long-range photographic potentials that the manufactures of American-made, third-generation, image intensifier night vision devices were unaware was possible.

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1. Cold War was a "term used to describe the shifting struggle for power and prestige between the Western powers and the Communist bloc from the end of World War II until 1989. Of worldwide proportions, the conflict was tacit in the ideological differences between communism and capitalist democracy" (*The Columbia Encyclopedia,* Sixth Edition, 2008, n.p., *Cold war*).

2. "Who makes a better investigator, men or women? It is impossible to say because it is more a question of the individual's qualifications than their gender. However, it is accurate to say that generally anything a man can do a woman can also do, and in certain instances women enjoy an advantage. One [private] detective agency, whenever it was necessary to interview a subject's neighbors using a pretext such as updating the person's credit, always sent an attractive female" (Siljander, R., 2008, p. 19).

This book provides no currently classified information. The United States Department of Defense (DOD) *Dictionary of Military and Associated Terms* (2008, October 17, n.p., *Classified information*) defines classified information as "Official information that has been determined to require, in the interests of national security, protection against unauthorized disclosure and which has been so designated." Some of the information in this book most likely would be designated as classified had a government-funded research facility developed it. Supporting that postulation are the types of image intensifier night vision technology specifications currently designated as classified, specifications such as maximum detection, recognition, and identification ranges, and the objective lens focal length of some night vision devices.

Law enforcement agencies, intelligence collection agencies, and military special operations forces employ photography in the field. In addition to specialized equipment such as camera adaptable image intensifier night vision devices and ultra-high-magnification optics, they use conventional off-the-shelf photographic equipment.[3] Nevertheless, when using conventional cameras and lenses, they employ operational techniques according to mission specific requirements. They use conventional photographic equipment in a manner necessary to support clandestine and covert operations.

This book presents information in a way that makes it useful for all users, which is necessary because the needs of each are varied. Fortunately, this approach to the topic is possible because all practitioners use the same methods but modify them according to need. For example, the methods for ultra-long-range photography using daytime optics and image intensifier night vision devices are the same whether the surveillance specialist represents law enforcement, an intelligence collection agency, or the military. Similarly, discussion of tactics such as infiltration and exfiltration, and camouflage and concealment applies to virtually all practitioners. As stated, each practitioner modifies the methods according to the situation.

The intention of this book is not to replace the photographic instructional material used by various government agencies. Rather, this book will supplement existing training materials and sharpen the photographic skills of the reader relative to manual clandestine photography. In that endeavor, this book does not attempt to tell readers how to do their job. Criminal investigators already know their job, as do intelligence agents and the members of military special operations forces. This book simply presents an inventory of

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3. The March 23, 1993, U.S. Army Field Manual FM 31-20-5, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces,* recommends using off-the-shelf still cameras and camcorders for Special Reconnaissance (SR) photography. To Americans, the term "off-the-shelf" means commercially available, for sale to civilians in retail stores.

techniques and methods from which the surveillance specialist can select and modify according to mission specific requirements.

If one consults a standard dictionary for the meaning of the words *covert* and *clandestine,* they appear to be synonymous. The two words appear to have the same meaning and therefore they appear to be suitable for interchangeable use. While civilians and the American law enforcement community tend to use the two words interchangeably, the United States Department of Defense (DOD) and the North Atlantic Treaty Organization (NATO) do not view them as being synonymous. To the DOD and NATO, covert means deniable and clandestine means concealed.

Planners of covert operations place importance on operational secrecy, but they place equal or greater significance on sponsor anonymity. In the event discovery of the operation occurs, nothing must exist to reveal the identity of the sponsor. Moreover, should the sponsor's identity be suspected, proof must be lacking so that the sponsor can categorically deny involvement or at least have a basis upon which to remain mute. *Covert means deniable!*

Planners of clandestine operations place importance on operational secrecy; protecting the identity of the sponsor usually is not necessary. For example, should a criminal discover that he is the subject of surveillance his knowing which law enforcement agency is responsible carries no consequence. Emphasis, therefore, is on concealment of the operation, keeping it a secret. Protecting the identity of the sponsor usually is not necessary. *Clandestine means concealed!*

Accepting that there is a difference between a clandestine operation and a covert operation, understand also that an operation can be both. Many clandestine operations are also covert operations. In such instances, strategists consider both concealment and deniability requirements.

The information in this book, as suggested by the title, pertains to manual clandestine photography, the photographing of a specific person, object, activity, or location while maintaining operational secrecy. The book is silent about methods to ensure sponsor anonymity. Nevertheless, stated earlier, except for being silent about ways to ensure sponsor anonymity, the photographic information in this book is suitable for covert operations.

In addition to being skilled photographers, surveillance specialists must be proficient in the clandestine arts, that too previously stated. This is essential because photographic skill without supporting tactical skills is as useless as a high-tech aerial camera without an aircraft to take it aloft. In each instance, the means to place the camera where needed is absent. Chapter 6 discusses tactics and strategies to the extent necessary to show how they apply to manual clandestine photography.

Clandestine photography teams acquire evidentiary photographs, or they acquire photographs containing information useful for intelligence purposes. In some instances, photographic images serve a dual purpose by containing both evidence and information useful for intelligence.

The authors wrote this book for readers who are digital photography and videography literate and physical surveillance skilled. The purpose of this book is not to teach photography and surveillance but to demonstrate how to apply photography to surveillance operations. For that reason, photographic and surveillance proficiency is prerequisite to acquiring all that one can from this book. Nevertheless, the authors realize that most practitioners of manual clandestine photography are not photographers per se. Stated another way, criminal investigators, intelligence agents, and military special operations forces personnel did not choose photography as a profession, but they do use photography as a job-related tool. The authors wrote and selected illustrative material with that realization. For that reason, even readers with limited knowledge of photography and surveillance will enjoy this book and benefit from it. They will acquire insight and understanding and they will discover what they need to learn in preparation for developing skill as a clandestine photographer. *Note: Some field personnel are highly proficient photographers and videographers in spite of not having chosen those disciplines as their primary career.*

Those without adequate photography knowledge and skill should enroll in digital photography classes and read books and journal articles on the topic. Discussing digital photography with experienced photographers also is important. Above all, however, the apprentice must acquire photography experience by taking numerous pictures under varied conditions, using also a camcorder. A person can learn a great deal and acquire skill through disciplined self-directed study and experimentation.

> For the things we have to learn before we can do them, we learn by doing them. Aristotle (384–322 BC)

People new to digital photography or new to manual clandestine photography should acquire understanding and skill by taking pictures indoors without a flash, and take pictures outdoors. Outdoors, take daytime pictures and nighttime pictures, and take pictures during dawn and dusk. Take available light pictures outdoors at night under varied artificial illumination, without a flash. Additionally, take daytime and nighttime pictures during rain, sleet, fog, and snow. Take pictures using various focal length lenses with emphasis on telephoto lenses. Experiment with low-light photography using a variety of ISO settings and experiment with underexposure shooting to RAW.

Devote considerable time experimenting with a graphics-editing program such as Adobe Photoshop®. Scrutinize the results of all experimental photography and keep a journal. Recording journal entries enhances the learning process and the notes are useful for future reference. Practice using a digital single-lens reflex camera and camcorder.

The primary value of this book is the information it provides to enhance skill as a clandestine photographer. Criminal investigators, intelligence agents, and military special operations forces (SOF) personnel who use photography must be skilled.[4] Contemplating the issue deeper brings to light the secondary value of this book, the contribution it makes to countering manual clandestine photography, countersurveillance, and counterintelligence, this issue mentioned earlier.

Those in the law enforcement and intelligence communities, and members of military special operations forces must know the photographic capability of the adversary. If the adversary is capable of photographically recording detail such as recognizable images of people and legible vehicle number plate during daylight hours from distances exceeding 1.609 kilometers (1 mile), that is not a problem. Similarly, if the adversary is capable of using an image intensifier night vision device with a camera to record similar detail at night from distances up to and exceeding 1.207 kilometer (0.75 mile), that is not a problem. A problem exists, however, if nobody knows the opposition has that capability.

Knowing what is photographically possible is prerequisite to defending against manual clandestine photography. This book discusses and illustrates photographic potentials that few people realize are possible. For that reason, this book makes a valuable contribution to counterintelligence, countersurveillance, and countermanual clandestine photography, previously stated.

Whether the reader uses the same brand of photographic equipment discussed and illustrated in this book is not important. That is because the pho-

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4. Physical surveillance is labor intensive and therefore expensive. Accordingly, clandestine photography teams are expensive. High costs require carefully selecting team personnel; be highly selective! Personnel must be intelligent, motivated, curious, capable of sound logic and reasoning, and able to stay on task in spite of boredom. Moreover, they must be creative in their thinking, capable of thinking beyond convention or, as some say, capable of thinking outside the box. Team members must be problem solvers who believe that where there is a will there is a way. Once assembling one or more photography teams, provide them the means to be successful. Provide them with quality equipment and training. Incurring the high costs of one or more photography teams and then failing to provide them the means to be effective and efficient is false economy. Do not permit the teams to exist in name only. When a photography team fails in their mission, evidence and/or intelligence is lost, even though paid for–payroll alone is a costly overhead item. When the enemy discovers a photography team because they lacked an adequate standoff capability, the team is in danger and the entire operation is in jeopardy, and information is lost. Clandestine photography teams must not operate with inadequate magnification; high-magnification telescopes suitable for terrestrial photography are affordable!

tographic principles discussed herein apply to virtually all makes and models of digital cameras and camcorders. All cameras and lenses are primarily the same regardless of brand name or specific operating features.

In this book, Canon products support much of the text and disproportionately the illustrations feature Canon products. The authors feature Canon products because Canon is the system they use. They are equally fond of Nikon but, like all photographers, they had to choose a camera system and Canon is the system they chose. Significantly, Nikon telephoto lenses are black while many Canon L-series telephoto lenses are white; for manual clandestine photography, black is preferred. Those using white Canon L-series lenses should apply a LensCoat™ Lens Cover when necessary, lens covers being available in a variety of camouflage patters in addition to black and white (www.lenscoat.com).

Manual clandestine photography occurs in a complex legal environment. Numerous laws govern what and whom a surveillance specialist may surreptitiously photograph, and under what circumstances photographing may occur. Furthermore, in the United States, laws vary by state and laws vary depending on whether the surveillance specialist is a civilian, law enforcement officer, an intelligence agent, or attached to a military special operations force. The laws also vary considerably from one country to another.

Ron Hankin[5], attorney, private investigator, author, commercial pilot, former FBI special agent, and former U.S. Marine Major generously contributed the informative discourse discussing legal issues of manual clandestine photography. Aside from that discourse, this book addresses manual clandestine photography with little regard for legal issues. The authors discuss and illustrate how to do it, not under what circumstances one may legally do it. It is the responsibility of each reader to determine when photographing is legal. Competent legal council is highly recommended whether obtained in-house or outside the agency. Know the law!

HISTORY OF MANUAL CLANDESTINE PHOTOGRAPHY

The Intriguing Journey from Yesterday to Today

The United States has carried out intelligence activities since the days of George Washington, but only since World War II have they been coordi-

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5. Hankin, R. (2009). *Navigating the legal minefields of private investigations: A career-saving guide for private investigators, detectives, and security police.* Flushing, NY: Looseleaf Law Publications, Inc. Website: www.Looseleaflaw.com. Telephone: 800.647.5547.

> nated on a government-wide basis. (Central Intelligence Agency, 2008, June 2, n.p., *History of the CIA*)
>
> During World War II, creation of the United States Office of Strategic Services (OSS), the predecessor of the CIA, and the establishment of the OSS Intelligence Photographic Documentation Project resulted in cameras becoming a standard tool of espionage.

Photography, like most technologies, began with discovery and then evolved to where its use became practical. Photography became useful in the mid 1800s but, being in a state of infancy, it was not immediately practical for investigative and intelligence applications; that came later.

Early cameras were large and heavy, and therefore conspicuous. For that reason, their usefulness for manual clandestine photography was limited. That changed with the introduction of the 35-millimeter camera, a camera well suited for investigation and espionage. This camera was small but it recorded high quality images. Later, the introduction of fast photographic films enhanced its value for investigation and espionage by making it suitable for low-light flash-free photography. With a 35-millimeter camera, investigators and intelligence agents had the ability to record numerous high quality images rapidly using only available light, and doing so inconspicuously. HighBeam Research, LLC (2005, n.p.), under the title *The Impact of New Technology,* explains the introduction of the 35-millimeter camera as follows:

> The development of the 35-mm or "candid" camera by Oskar Barnack of the Ernst Leitz company, first marketed in 1925, made documentarians infinitely more mobile and less conspicuous, while the manufacture of faster black-and-white film enabled them to work without a flash in situations with a minimum of light.

Law enforcement agencies used photography prior to World War II (1939–45), as did the intelligence collection agencies of various countries. Nevertheless, use of photography for intelligence collection purposes was sporadic. As for America, during World War II, creation of the United States Office of Strategic Services (OSS) and the establishment of the OSS Intelligence Photographic Documentation Project resulted in cameras becoming a standard tool of espionage. The Central Intelligence Agency (CIA) website in a discourse titled *History of the CIA* (2008, June 2, n.p.), reports that, "The United States has carried out intelligence activities since the days of George Washington, but only since World War II have they been coordinated on a government-wide basis." Under the title, *A Look Back . . . John Ford: War*

Movies, Filming for the OSS (2009, January 9, n.p.), the Central Intelligence Agency website further reports that:

> Film had not been used extensively during a war before, but with the beginning of World War II, it became apparent that it could serve a number of purposes: Boost propaganda and morale, train the troops, provide intelligence, and record historical events. . . . Ford [Hollywood film director] pioneered the use of film during wartime, and his efforts with the OSS led to the establishment of the OSS Intelligence Photographic Documentation Project.

During World War II, on June 13, 1942, United States President Franklin D. Roosevelt issued an order creating the Office of Strategic Services (OSS), the OSS being the predecessor of the Central Intelligence Agency (CIA). World War II ended September 1945 and shortly thereafter "President Truman recognized the need for a postwar, centralized intelligence organization. To make a fully functional intelligence office, Truman signed the National Security Act of 1947 establishing the CIA" (Central Intelligence Agency, 2008, June 2, n.p., *History of the CIA*). Since then, "The Intelligence Reform and Terrorism Prevention Act of 2004 amended the National Security Act" (Central Intelligence Agency, 2008, June 2, n.p., *History of the CIA*).

During World War II and later during the Cold War various camera models enjoyed clandestine use with many methods of application being impressively creative. The small sampling of cameras illustrated here deserves acknowledgment and a place in the history of manual clandestine photography.

Eastman Kodak Matchbox Camera. During World War II, for the United States Office of Strategic Services (OSS), forerunner of the Central Intelligence Agency (CIA), the Eastman Kodak Company created the Eastman Kodak Matchbox Camera, also called Camera-X. American and European agents and members of Resistance movements in German occupied Europe used this simple but effective camera (see Figure 1-3). The manufacturer designed this user-friendly camera for use by photographically untrained people under adverse conditions. Designed for covert operations, this camera reflects no brand name or country of origin.

Camera-X uses 16-millimeter film, features an image format of 14x14 millimeters, records 34 images per roll of film, and contains a 25-millimeter fixed-focus lens with two aperture settings, f/5.0 and f/8.0. The fixed-focus lens features a hyperfocal range of 1.3716 meters (4.5 feet) to infinity.[6] The

6. A lens set to the hyperfocal distance features a point of perfect focus with objects at half that distance to infinity being in acceptable focus. Only objects at the hyperfocal distance are in perfect focus.

Figure 1-3. Designed for covert operations during the Second World War, the Eastman Kodak Matchbox Camera, also known as Camera-X, is about the size of a matchbox of that era and reflects no brand name or country of origin. This camera records average quality images. Image courtesy of Westlicht Vienna.

guillotine shutter features 2 speeds, B and 1/60. The CIA Museum website, in an article titled *"Matchbox" Camera* (2009, January 12, n.p.), explains that:

> The Eastman Kodak Company developed and manufactured this camera for use by the Office of Strategic Services (OSS). It was made in the shape of a matchbox of that era. It could be disguised by adding a matchbox label appropriate for the country in which it was to be used. . . . It was deployed "behind the lines" by resistance personnel in World War II for target recording and propaganda photography. Designed to be operated with a minimum of user-adjustable settings, the Matchbox Camera featured rugged construction and controls that could be operated by "feel."

Robot Star 50 Camera. Various models of the German made Robot camera saw service during World War II and the Cold War. Evolution of this well engineered camera resulted in the Star 50 Camera with certain models designed for concealment in a woman's purse (see Figure 1-4).

The Encyclopedia of Espionage, Intelligence, and Security, in a discourse titled *Surveillance Cameras in Espionage* (Knight, 2008, n.p.), reports that:

> First used by the Nazis in 1934, the robot could snap multiple exposures without requiring manual winding. Originally used by the German air force . . . it later became a favorite of Nazi intelligence services. The designs of the

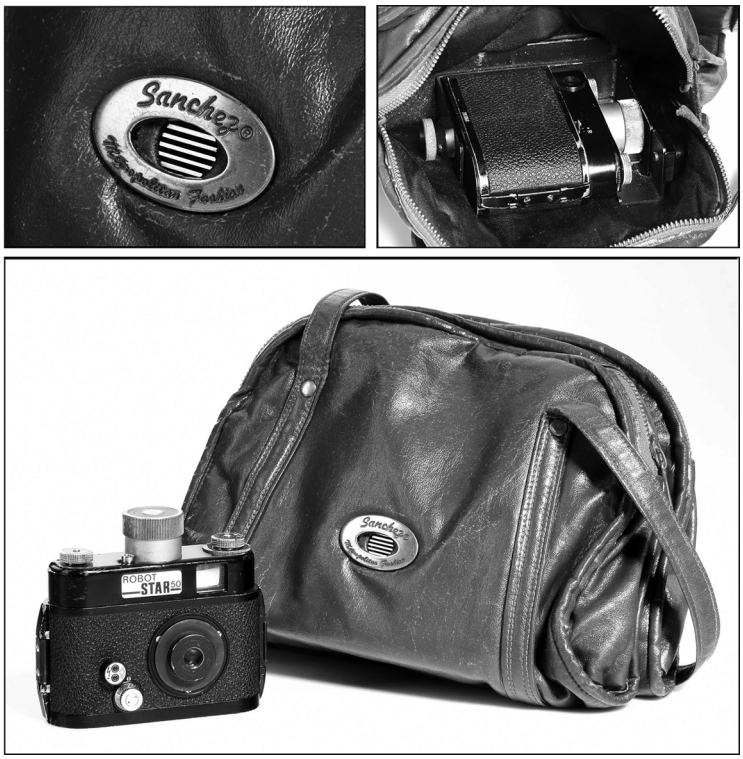

Figure 1-4. The German made Robot Star 50 camera was one model within the Robot series of cameras that became a favorite of Nazi intelligence services during the Second World War. Following the war, intelligence agents on both sides of the Iron Curtain[7] used robot cameras. Images courtesy of Westlicht Vienna.

> Nazi era culminated in the Star 50, which could snap 50 exposures in rapid succession. After the war, intelligence agents on either side of the Iron Curtain used robot cameras. . . . Made to be concealed and, if necessary, operated from a remote location, the robot was ideal for surveillance.

The Robot camera series, first made available in 1934 with a variety of models produced over the years, is another example of fine German engineering. An excellent Wikipedia® article titled *Robot (camera): Robot Star* (2008, December 19, n.p.) provides the following summary of this superb camera:

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7. The term Iron Curtain refers to "the political, military, and ideological barrier erected by the Soviet Union after World War II to seal off itself and its dependent eastern European allies from open contact with the West and other noncommunist areas" (Encyclopedia Britannica Online, 2010, n.p., *Iron curtain*).

Figure 1-5. Today's compact digital still cameras and miniature camcorders are so small that had they existed during the Second World War and much of the Cold War, classifying them as spy cameras is likely. *Upper camera:* The modern Olympus Stylus 1030 SW 10.1 megapixel shockproof, waterproof, freezeproof, and dustproof compact digital camera measures only 93.6 x 60.9 x 21.3 millimeters (3.7 x 2.4 x 0.84 inches). *Lower camera:* The Minox B camera enjoys a well-deserved place in the history of espionage. Indeed, "The Minox subminiature camera, in its various models, was the world's most widely used spy camera" (CIA Museum, 2008, June 2, n.p.). In the closed position, the Minox B measures only 10.01 x 2.79 x 1.60 centimeters (3.94 x 1.10 x 0.63 inches). *Right image:* Leather case for the Minox B camera.

> During the Cold War, Robots had a large following in the espionage business. The small camera could be concealed in a briefcase or a handbag, the lens poking though a decorative hole. The camera could be activated repeatedly by a cable release concealed in the handle. The company was well aware of this market and produced a variety of accessories which made the camera even more suitable for covert image making. . . . For an extra fee, Robot-Berning supplied silenced versions with nylon gears for discrete use. Within its limits, the Robots did an excellent job of sequence photography. The standard 38 mm f2.8 Xenar lenses were extremely sharp, even by today's standards. . . . The reliable motor drive was as fast, if not faster, than current electrical drives and there were no batteries to run down.

Minox Subminiature Camera. The Minox subminiature camera is another example of fine German engineering with this camera series being the world's most widely used camera for espionage (see Figure 1-5). Of the various Minox camera models, the Minox B featured most prominently in the

history of espionage. The website of the CIA Museum in a discourse titled, *Minox Camera* (2008, June 2, n.p.) describes the Minox subminiature camera as follows:

> The Minox subminiature camera, in its various models, was the world's most widely used spy camera. When it first became available, the camera was considered a marvel of technology. . . . The ultra-light aluminum shell Minox B was produced from 1958–1972. Because of its small size, it was easy to conceal. It could take excellent photographs of documents at close range and was a natural for secret photography. . . . The Minox C was introduced in 1969. . . . Convicted KGB spy John A. Walker, Jr., used a Minox C to photograph sensitive National Security Agency codes.

CamBinox Photo-Binocular. Another example of innovation and fine German engineering is the J. D. Möller Wedel CamBinox Photo-Binocular, a 7x35 binocular containing a subminiature still camera. The camera records 20 exposures on 16-millimeter film, frame size 10x14 millimeters. The 90-millimeter f/3.5-16 camera lens is high quality and provides the same aspect ratio as the binocular. The shutter speed varies from 1/30 to 1/800 second. A single action advances the film, cocks the shutter, and records the exposure number. The Bundesnachrichtendienst, BND (German Secret Service/ Federal Intelligence Service) was the original user (see Figure 1-6).

It is unfortunate that nobody manufactures a modern, well-conceived, high quality digital camera/camcorder binocular with a reasonably fast autofocus camera lens featuring the same aspect ratio as the binocular. A truly high quality product would be expensive and perhaps low sales volume does not justify manufacturing such a product. Surveillance specialists would find such a binocular very useful.

Asahi Pentax NOCTA. In 1966, Pentax introduced the full-frame 35-millimeter Asahi Pentax NOCTA single-lens reflex (SLR) infrared camera (see Figure 1-7). Designed for photography in total darkness using Kodak High-Speed Infrared Film, the camera features a 300-millimeter f/3.3 permanently mounted lens. The camera contains an image converter tube operating on the same principle as the converter tube in the World War II sniper scope. The camera features two radiation sources, a continuous source for viewing and focusing and an instantaneous source to expose the film when taking a picture. The manufacturer reported that the system was capable of photographing up to 91.44 meters (300 feet).

In the mid-1970s, a Honeywell representative told one of the authors that this infrared camera was a marketing disappointment because of timing. The manufacturer introduced this camera about the time that first generation (Gen I) image intensifier night vision devices (Starlight Scopes) became avail-

Figure 1-6. This 1958 model of the German made J. D. Möller Wedel CamBinox Photo-Binocular is a 7x35 binocular containing a 16-millimeter subminiature still camera. The camera lens provides the same aspect ratio as the binocular. Images courtesy of Westlicht Vienna.

able to law enforcement. In 2007, declining demand resulted in Kodak discontinuing production of High-Speed Infrared Film. *Note:* The early Gen I night vision devices (NVDs) that this camera competed with, the NVDs used by the military and law enforcement, contained three image intensifier tubes

Figure 1-7. Introduced by Pentax in 1966, the full-frame 35-millimeter Asahi Pentax NOCTA single-lens reflex (SLR) infrared camera permitted photography in total darkness using Kodak High-Speed Infrared Film. Although this innovative product saw little service because of the almost simultaneous appearance of the Starlight Scope image intensifier night vision device, it enjoys a deserving place in the history of manual clandestine photography. Image courtesy of Honeywell Pentax.

mounted in series. Today, the Gen I night vision devices on the civilian market contain one intensifier tube and therefore they are not comparable to the early Gen I devices used by the government. The early Gen 1 NVDs, those featuring three intensifier tubes, performed well.

THE IMPORTANCE OF MANUAL CLANDESTINE PHOTOGRAPHY

> A well-taken picture is truly worth a thousand words. In the conduct of Special Reconnaissance, Special Forces photography is often an invaluable skill. . . . The SFOD [Special Forces Operational Detachment] can collect, confirm, or reinforce technical information through on-the-ground photographic surveillance, which cannot be done by more technical means. (Department of the Army, 1993, March 23, p. C-9, *FM 31-20-5, Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*)

Changing Circumstances Changed Intelligence Needs

The December 1991 collapse of the Soviet Union changed America's national intelligence requirements. That in turn altered priorities, which affected how intelligence agencies operate. The collapse of the Soviet Union and the contemporary proliferation of organized crime coupled with the lethality of the so-called new terrorism changed the priorities of intelligence collection. Also affecting security requirements is the proliferation of street gangs and the dangers of homegrown terrorism. Circumstances today beg cooperation between federal intelligence agencies and law enforcement agencies.

Today, instead of having to place monitoring emphasis on one large slow moving target, the Soviet Union, intelligence agencies must monitor many small but highly lethal fast-moving and sometimes unidentified targets. Some of the actors are state sponsored and some are not. Aris A. Pappas and James M. Simon, Jr. (2007, April 14, n.p.), senior officers on the Intelligence Community Management Staff under the Director of Central Intelligence, explain this situation in a discourse titled *The Intelligence Community: 2001–2015. Daunting Challenges, Hard Decisions.* They report that, "The single, massive threat of the Soviet Union has been replaced by a series of smaller, but individually highly destructive threats that are harder to monitor."

The collapse of the Soviet Union in 1991 and the September 11, 2001 terrorist attacks against the United States ten years later left intelligence agencies with a different set of priorities. In 1993, the United States Navy acknowledged that intelligence collection priorities had changed. Fourteen years later, 2007, Aris A. Pappas and James M. Simon, Jr. confirmed that what the Navy reported still held true. They each reported as follows:

> The purpose of intelligence or reconnaissance photography is to gain information about an enemy or potential enemy. Now that the Soviet Union has been disestablished, the Russian threat to our national security has been greatly reduced. This does not suggest that intelligence photography is no longer required, but that our focus on other threats has intensified. Whether it be interdiction of drug smuggling operations from South or Central America or the potential nuclear threat of a third world nation, the need for intelligence photography will always exist. (United States Navy, NETPTDC 14209, 1993, October, p. 6–41, *Photography (Basic)*)

> Today, our needs are more disparate and numerous. We must recruit in more places and against more targets. Terrorist groups, in particular, are small and physically dispersed, but have tight, almost family-like cohesion. These new realities all increase significantly our need for a larger, broadly

> deployed, and well supported clandestine service. (Pappas and Simon, Jr., 2007, April 14, n.p.)

Intelligence agencies and law enforcement must be responsive to contemporary threats. Proactive intelligence collection and interagency cooperation is essential and must acknowledge that, in some respects, nonstate actors are more dangerous than hostile state actors are. Uriel Rosenthal and Erwin Muller (2007, p. 147) address this issue quoting P. Zimmerman and J. G. Lewis. They reported that, "Recently [December 2006] American intelligence experts said that terrorist groups are more likely than states to use weapons of mass destruction. In this context they refer to a 'greater-than-ever risk.'"

The result of the threat created by the new terrorism and the proliferation of organized crime and street gangs is recognition of the need for better human intelligence. The increased need for human intelligence carries with it an increased need for field agents being skilled photographers. More than ever before, manual clandestine photography is an essential tool of security, espionage, and counterespionage.

Still cameras and camcorders are valuable evidence- and intelligence-collection tools that document important information. Cameras document information that the surveillance specialist both saw and failed to see, or that the specialist saw but failed to realize was important.

Organized Crime

> The global traffic of illicit drugs, the increasing number of domestic and transnational crime syndicates, the prevalence of street gangs, and domestic and international terrorism make manual clandestine photography an essential investigative and intelligence collection tool.

Today, globally, organized crime in various forms is out of control and threatens the political, economic, and social stability of nations, and terrorism is an equally insidious threat. Additionally, the global problem of illicit drugs persists and street gangs remain a societal blight. Adding to the challenge is the fact that these forces do not always operate independently of each other.

The illicit drug problem is an organized crime-related dilemma of worldwide proportions that is out of control in the United States and the American government struggles with little success to eliminate the scourge. In their book *Street Drug Investigation,* Fredrickson and Siljander (2004, p. 7) discuss the government's drug control efforts reporting that:

> In response to the persistent problems created by illicit drugs, in 1968 the Bureau of Narcotics and the Bureau of Drug Abuse Control merged to create the Bureau of Narcotics and Dangerous Drugs (BNDD). In 1973, merging the Bureau of Narcotics and Dangerous Drugs, the Office for Drug Abuse Law Enforcement, and the Office of National Narcotics Intelligence created today's Drug Enforcement Administration (DEA). In 1992, Congress created the Substance Abuse and Mental Health Services Administration (SAMHSA), which is an agency of the U.S. Department of Health and Human Services (HHS), and in 1993, the National Drug Intelligence Center (NDIC), was established. Moreover, today, virtually every major police department features a drug enforcement bureau staffed by officers whose responsibility it is to investigate violations of anti-drug laws.

Many organized crime syndicates are transnational in scope and therefore affect many countries. For example, as of 2007, 950 organized crime groups were operating in Canada according to a Canadian government report titled *Organized Crime: It's in Your Neighborhood. Statistics* (2007, August 29, n.p.). The report states that, "Nearly 950 organized crime groups are operating in major urban centres and smaller communities in Canada with varying levels of sophistication." The report went on to state that, "Over 300 street gangs have been identified, with an estimated 11,000 gang members and associates."

In the United States, the organized crime problem is serious. In a discourse titled *About Organized Crime* (2008, n.p.), the Federal Bureau of Investigation (FBI) reports that, "In fiscal 2005, we had 651 pending investigations related to Italian organized crime and labor racketeering alone. We had another 468 cases related to Asian and African criminal enterprises, plus investigations into groups affiliated with other parts of the globe."

Canada and the United States are not alone. The United Nations Department of Public Information, in a report titled *Fighting Transnational Organized Crime* (2000, March, n.p.) reported that Russia suffers a serious post Cold War era organized crime problem. An excerpt from the report reads as follows:

> The number of known criminal groups in Russia increased between 1990 and 1997 from 785 to an astronomical 9,000, with a combined membership of more than 100,000, according to the country's Interior Ministry. In Moscow, some 189 criminal organizations were active in 1996, of which 23 had branches abroad.

Organized crime presents a serous threat to the political, economic, and social stability of numerous countries, as stated. In a report titled *Global*

Studies on Organized Crime (1999, February, p. 4), the United Nations Interregional Crime and Justice Research Institute attests to this. The discourse reports that:

> In the last decade, organized crime groups have expanded their dimension and activities worldwide and are currently a global threat posing a concrete danger to the international community. Criminal groups have established international networks to better carry out their activities both in licit and illicit markets by employing sophisticated strategies and diverse modus operandi. As a result, they are able to infiltrate the financial, economic and political systems of countries all over the world.

Outlaw Motorcycle Gangs and Organized Crime

> Contrary to what outward appearances may suggest, many so-called outlaw bikers are intelligent and educated and the clubs have an intelligence capability that law enforcement cannot legitimately ignore.

Commonly, when confronted by the subject of organized crime, people in America tend to think of the Italian Mafia. Unfortunately, the Mafia is only one of countless organized crime groups operating today, many groups being transnational in scope. The Mafia is an old crime syndicate that the entertainment industry and news media romanticized, but no crime syndicate deserves romanticism.

Today, counted among the numerous crime syndicates are some so-called outlaw motorcycle gangs (clubs) that have become large, international in scope, and illicit in some of their activities. Many bikers refer to outlaw motorcyclists as one-percenters; they represent an estimated one-percent of motorcyclists.

Most motorcyclists are not criminals, and not all motorcyclists are bikers. Understand that there is a difference between a motorcycle enthusiast and a biker. Bikers are members of a multistrata subculture while motorcycle enthusiasts are not.

Sergeant Steve Tretheway, Arizona Department of Public Safety, and Lieutenant Terry Katz, Criminal Intelligence Division, Maryland State Police, confirm that some motorcycle gangs (clubs) have evolved into organized crime syndicates. In a discourse titled *Motorcycle Gangs or Motorcycle Mafia?* they report that:

> Documented evidence in state, provincial and federal courts throughout the United States, Canada, Europe and Australia suggests that motorcycle gangs have become organized crime entities equal to the Mafia on many fronts.

> Biker gangs are organized internationally, with chapters in Europe, Australia, South America and Africa. (Tretheway & Katz, 1998, n.p.)

Contrary to what outward appearances may suggest, many so-called outlaw bikers are intelligent and educated and the clubs have an intelligence capability that law enforcement cannot legitimately ignore. Tretheway and Katz (1998, n.p.) confirm this reporting that:

> . . . many of today's biker gang members and associates are earning college-level degrees in computer science, finance, business, criminal justice, and law. These curricula improve the gang's expertise in highly profitable criminal enterprises. Education has allowed gang associates to entrench themselves in government positions (including the military) and other legitimate professions. These legitimate jobs give gang associates access to technology, weapons and other informational banks where security records, motor vehicle files, personal data and police reports are maintained.

In their racial profiling book, Fredrickson and Siljander echoed the observations of Tretheway and Katz, confirming that Motorcycle gangs (clubs) that evolved into organized crime syndicates have an impressive but disturbing intelligence capability. Fredrickson and Siljander (2002, p. 116) reported that:

> Large [motorcycle] clubs that are well organized have an impressive intelligence collection capability exceeded only by government. Their members, the member's women, and non-members who associate with them hold jobs in nearly all segments of business, industry, and government at various levels. Hence, there is very little information they do not have access to by one means or another.

Tretheway and Katz (1998, n.p.) confirm the above statement regarding gang associates, reporting that:

> Estimates suggest that for every gang member, there are 10 associates doing work for the gang. They may obtain utility or criminal justice information, provide sophisticated weapons and other equipment through military connections, or offer their services as chemists, thieves, prostitutes and even contract hit men.

Large motorcycle gangs (clubs) that evolved into criminal enterprises have the financial capability to corrupt government officials and private-sector personnel in critical positions.

Street Gangs

> Gangs more deadly than some Gitmo detainees. The chief judge of the federal court in Washington told lawyers Thursday that domestic street gangs are more deadly than some Guantanamo Bay detainees who could face trial in U.S. courts. (Barrett, D., 2009, December 17, n.p.)

Street gangs are a serious problem in the United States and in many other countries. At the website of the Federal Bureau of Investigation (FBI), under the heading *Violent Gangs*, the FBI reports:

> About 20,000 violent street gangs, motorcycle gangs, and prison gangs with approximately 1 million members are criminally active in the U.S. today. Many are sophisticated and well organized; all use violence to control neighborhoods and boost their illegal money-making activities, which include drug trafficking, robbery, theft, fraud, extortion, prostitution rings, and gun trafficking. (FBI.gov., n.d., n.p.)

The prevalence of gangs requires law enforcement to investigate gang-related crime, and engage in criminal intelligence operations. Both activities require extensive surveillance supported by manual clandestine photography. Clandestine photography relative to gangs involves but is not limited to photographing the activities of gang members, documenting gang membership, and documenting gang associates.

International Terrorist Organizations

> . . . the Iranians have a very sophisticated terrorist infrastructure in the United States, in Mexico and in Canada. (Meyers, J., 2010, August 26, n.p.)

Numerous sources attest to the seriousness of international terrorism and the need for a unified global effort to combat the scourge. Unfortunately, for a variety of reasons, cooperation is not always complete. Combating international terrorism requires understanding its dynamics, keeping abreast of changes, identifying the actors, and determining the capabilities of the various terrorist groups. Combating international terrorism requires the efficient acquisition and analysis of information, and the sharing of intelligence. Acquiring intelligence requires, among other things, technical and physical surveillance, and manual clandestine photography.

The following information from three different sources defines international terrorism, verifies the prevalence of nonstate actors, attests to the intelligence collection capability of some terrorist organizations, and predicts that terrorists will demonstrate increasing lethality.

> International terrorism involves violent acts or acts dangerous to human life that are a violation of the criminal laws of the US or any state, or that would be a criminal violation if committed within the jurisdiction of the US or any state. Acts of international terrorism are intended to intimidate or coerce a civilian population, influence the policy of a government, or affect the conduct of a government. These acts transcend national boundaries in terms of the means by which they are accomplished, the persons they are intended to intimidate, or the locale in which perpetrators operate. (FBI.gov, 2002, March 1, n.p., *Congressional Testimony: Terrorism Preparedness.*)

> Since the disintegration of the Soviet Union and the end of the Cold War, nonstate actors (e.g., terrorist organizations, militias, and drug cartels) have developed sophisticated intelligence and counterintelligence capabilities that rival those of some states. . . . Today, terrorists and drug traffickers from the jungles of Colombia to the streets of Western Europe employ advisers drawn from the intelligence services of the former Soviet Union, East Germany, and Yugoslavia and use criminals of various kinds to bribe or terrorize their opponents and protect their organizations. . . . Operations against such organizations require smaller and more-flexible intelligence services. . . . (Ransom, H. H. and Pringle, R. W., 2009, n.p.)

> Between now and 2015 terrorist tactics will become increasingly sophisticated and designed to achieve mass casualties. We expect the trend toward greater lethality in terrorist attacks to continue. (National Intelligence Council, 2000, December, *Global Trends 2015,* n.p.)

In a report titled *Country Reports on Terrorism* (2007, April 30, n.p.), the U.S. Department of State identifies 42 terrorist organizations. In an earlier report, *State Sponsors of Terrorism* (2006, April 28, n.p.), the U.S. Department of State identifies Cuba, Iran, North Korea, Sudan, and Syria as being sponsors of international terrorism.

Subsequent to the September 11, 2001, terrorist attacks against the World Trade Center in New York City, New York (USA) and the Pentagon in Arlington, Virginia (USA), the United States Bureau of Alcohol, Tobacco and Firearms (ATF) was renamed the Bureau of Alcohol, Tobacco, Firearms and Explosives. The ATF at their website, under the heading *ATF's History* (n.d.), explains that:

> Effective January 24, 2003, the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) was transferred under the Homeland Security bill to the Department of Justice. The law enforcement functions of ATF under the Department of the Treasury were transferred to the Department of Justice. The tax and trade functions of ATF will remain in the Treasury Department with the new Alcohol and Tobacco Tax and Trade Bureau. . . . In addition, the

agency's name was changed to the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) to reflect its new mission in the Department of Justice.

The September 11, 2001, terrorist attacks directed against the United States were not isolated incidents but one more in a series of attacks against American interests. Moreover, the so-called 9/11 terrorist attacks illustrate the lethal determination of some terrorist organizations to destroy America. The U.S. Army publication *A Military Guide to Terrorism in the Twenty-First Century* defines terrorism as the "premeditated politically-motivated violence perpetrated against non-combatant targets by sub-national groups or clandestine agents" (U.S. Army TRADOC G2 Handbook No. 1, 2007, August 15, p. 1–2).

For the United States Center for Defense Information, Christopher Hellman, CDI Senior Analyst, and Reyko Huang, CDI Research Analyst (2008, June 16), compiled a list of known terrorist organizations[8] considered by the U.S. State Department to be active during the last five years. The list identifies 56 terrorist organizations located in various countries. This number, 56, conflicts with the earlier number, 42, provided by U.S. Department of State. Issues such as definition and period can skew numbers, but, for purposes of this discussion, that is not important. Whether 42 or 56 terrorist organizations operate in the world is less important than the fact that terrorist organizations exist at all, and it is less important than their homicidal ambitions and capabilities.

Domestic Terrorism: Homegrown Terrorists

> Domestic terrorism is the unlawful use, or threatened use, of violence by a group or individual based and operating entirely within the United States (or its territories) without foreign direction, committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives. (FBI.gov, 2002, March 1, n.p., *Congressional Testimony: Terrorism Preparedness.*)

During America's history, a variety of extremist groups have existed at different times for different reasons. Some groups engage in acts of terrorism intending to cause political change while specific issues motivate other groups. Some groups are content with rhetoric while other groups engage in acts of terrorism.

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8. The U.S. State Department's list of Foreign Terrorist Organizations (FTOs) began in 1997 as a method of tracking down and striking back against specific terrorist groups around the world. FTOs are designated as such based on a demonstrated capability and/or willingness to engage in terrorist methods that threaten the U.S. national security interests.

Today, extremist groups exist that commit acts of terrorism and there are groups wherein the potential for acts of terrorism is high. The United States remains home to leftwing and rightwing extremists, antigovernment militias, eco-terrorists, and extremist animal rights advocates. Additionally, at the time of this writing, the "U.S. faces 'Americanization' of terror threat" wherein authorities are witnessing "the radicalization of Muslims in the United States" to an extent that "The U.S. is arguably now little different from Europe in terms of having a domestic terrorist problem involving immigrant and indigenous Muslims as well as converts to Islam" (Reuters Limited. Yahoo! Inc., 2010, September 10, n.p.).

In recent years, so-called eco-terrorists and extremist animal rights groups have caused considerable property damage. Organizations such as the Animal Liberation Front (ALF) and Earth Liberation Front (ELF) seek no broad social or political changes. Rather, they are special interest extremist groups. Under the title *Congressional Testimony: The Threat of Eco-terrorism* the Federal Bureau of Investigation (2002, February 12, n.p.) explains that:

> During the past decade, we have witnessed dramatic changes in the nature of the terrorist threat. In the 1990s, right-wing extremism overtook left-wing terrorism as the most dangerous domestic terrorist threat to the country. During the past several years, special interest extremism, as characterized by the Animal Liberation Front (ALF) and the Earth Liberation Front (ELF), has emerged as a serious terrorist threat. Generally, extremist groups engage in much activity that is protected by constitutional guarantees of free speech and assembly. Law enforcement becomes involved when the volatile talk of these groups transgresses into unlawful action. The FBI estimates that the ALF/ELF have committed more than 600 criminal acts in the United States since 1996, resulting in damages in excess of 43 million dollars.
>
> Special interest terrorism differs from traditional right-wing and left-wing terrorism in that extremist special interest groups seek to resolve specific issues, rather than effect widespread political change. Special interest extremists continue to conduct acts of politically motivated violence to force segments of society, including the general public, to change attitudes about issues considered important to their causes. These groups occupy the extreme fringes of animal rights, pro-life, environmental, anti-nuclear, and other movements. Some special interest extremists–most notably within the animal rights and environmental movements–have turned increasingly toward vandalism and terrorist activity in attempts to further their causes.

Survivalist, militia, white supremacist, leftwing extremist, rightwing extremist, and antigovernment militia are familiar terms. Many terms loosely apply to various groups that emphasize preparedness in order to survive a

cataclysmic event whether it is a natural disaster, economic collapse, the disintegration of social order, or an unjustly overbearing government. Extremist groups form in response to social and political circumstances that they feel are unacceptable and threatening.

Some survivalist groups are harmless and simply try to be prepared for the unexpected, while other groups are antisocial, antigovernment, some anti-American, and some are dangerous. Antigovernment militia groups require monitoring because at some point raucous rhetoric could evolve into action in those instances where it has not already done so.

Jason Bauer, while a senior political science student enrolled in SOCI 360, Social Movements, at James Madison University, Harrisonburg, Virginia (USA), for an academic writing contest, wrote a research paper titled *The Blood of Patriots: A Critical Analysis of the Anti-government Militia Movement in 21st Century America.* The paper, a second place winner, is an informative discourse that Mr. Bauer describes as follows:

> This study examines the American anti-government militia movement in a critical sociological context. The movement's participants, political ideology, forms of rhetoric, and current priorities are discussed. In the wake of the September 11 [2001] attacks, an understanding of America's home-grown terrorists is crucial to future political and social discourse. (Bauer, J., 2002, n.p.)

Extremist organizations operate independently of each other. In that respect, they are fragmented and uncoordinated. Similarly, their views vary from one group to another yet ideological similarities exist. Jason Bauer (2002, p. 4), in the above mentioned discourse, *The Blood of Patriots,* explains the motivating ideologies of militia groups as follows:

> Militias are founded in one (or occasionally more than one) of several ideologies. The majority are simple political militias, whose members believe that the government is attempting to take away the rights of American citizens to bolster its own corrupt power base. . . . Increasing numbers of militias have begun to incorporate religious or racial overtones into their practices. . . . Militias of both types are often firmly grounded in the practice of survivalism. Survivalists are individuals who believe that they must be self-sufficient and capable of protecting themselves should the order of the world collapse and the country fall into civil war or other disturbance. Survivalists tend to engage in paramilitary training and often cache large quantities of weapons, ammunition, food, and supplies.

Not surprising, the membership of extremist anti-government groups increases and decreases in response to social, political, and economic forces

as they affect fears and ideology. In the United States, at the time of this writing, there is an increase in the number of extremist groups and membership is up. Reasons include a weak economy, gun control legislation and the fear of repressive legislation, and some worry about the intentions of the current administration. Predictably, the forces that cause increased membership in extremist organizations are the same forces that encourage increasing weapon and ammunition supplies, and intensification of paramilitary training.

The U.S. Homeland Security report titled *Rightwing Extremism: Current Economic and Political Climate Fueling Resurgence in Radicalization and Recruitment* (2009, April 7, n.p.) verifies the stockpiling of weapons and ammunition, and paramilitary training. An excerpt from the report states that, "Many rightwing extremist groups perceive recent gun control legislation as a threat to their right to bear arms and in response have increased weapons and ammunition stockpiling, as well as renewed participation in paramilitary training exercises."

Not everybody who shares the fears entertained by members of antigovernment militia groups join such groups. Nevertheless, many people feel the need to prepare by increasing their ammunition and weapon supply for purposes of personal and home defense. An excerpt from the previously mentioned *Rightwing Extremism* (2009, April 7, n.p.) report confirms this stating that, "Both rightwing extremists and law-abiding citizens share a belief that rising crime rates attributed to a slumping economy make the purchase of legitimate firearms a wise move at this time."

The number of antigovernment militia groups and their membership has risen in recent years, as stated. Also stated is the fact that ideology and a predisposition for violence varies from one group to the next. In spite of somewhat differing ideology, however, all violent extremists in America have one thing in common and that is they are a threat to the security of the American people. Because antigovernment militia groups are fragmented, violent actions tend to be sporadic and uncoordinated. Nevertheless, some groups are dangerous and require monitoring.

The Lone Wolf

> The specter of the lone-wolf terrorist is what most worries law-enforcement officials. . . . A top FBI counterterrorism official says the bureau's "biggest concern" is "the individual who has done the training, has the capability but is disenchanted with the group's action–or in many cases, inaction–and decides he's going to act alone." . . . . the creation of monsters in their midst is the greatest danger posed by organized groups. (Gellman, B., 2010, October 1, n.p.)

In addition to extremist groups are the so-called lone wolves, individuals embracing a violent and extremist ideology but operating alone or largely alone. They are exceedingly dangerous because they are under the proverbial radar with authorities often being unaware of them until they commit an act of terrorism.

Lone wolves are difficult to detect prior to committing an act of violence, and the number of lone wolf attacks has increased in recent years. Matthew Harwood, Associate Editor, *Security Management Online,* wrote that "Domestic terrorist attacks perpetrated by individuals, or lone wolves, have increased since Timothy McVeigh's bombing of a federal building in Oklahoma City 15 years ago, reports a terrorism research organization" (Harwood, 2010, April 26, n.p.).

Some lone wolves have ambition without capability but some are very capable. Pakistani-born Faisal Shahzad who, May 1, 2010, attempted to detonate a vehicle bomb in Times Square, New York City, New York (USA), was ambitious but not capable. His explosive apparatus failed with the result being no property damage or human casualties. Although operating largely as a lone wolf, he allegedly had ties to elements of the Pakistani Taliban.

In contrast to Faisal Shahzad who was incompetent, the American born lone wolf terrorist, Timothy McVeigh, was capable. April 19, 1995, he detonated a vehicle bomb in Oklahoma City, Oklahoma (USA). The explosion destroyed the Alfred P. Murrah Federal Building and killed 149 adults and 19 children. The explosion also damaged other buildings in the area, some damaged beyond repair and subsequently razed. After the attack, one of the authors visited the site and was shocked at the extent of collateral property damage. McVeigh was capable with the result being that his was the deadliest terrorist attack in American history up to that time.

Tried, convicted, and sentenced to death, on June 11, 2001, Timothy McVeigh died by means of lethal injection at the United States Federal Penitentiary in Terre Haute, Indiana (USA). As for Faisal Shahzad, June 21, 2010, he pleaded guilty to multiple charges. October 5, 2010, he received a sentence of life in prison.

The *Rightwing Extremism* (2009, April 7, n.p.) article referenced earlier acknowledges the danger that lone wolf and small terrorist cells represent. The report explains that, "lone wolves and small terrorist cells embracing violent rightwing extremist ideology are the most dangerous domestic terrorism threat in the United States. Information from law enforcement and non-governmental organizations indicates lone wolves and small terrorist cells have shown intent–and, in some cases, the capability–to commit violent acts."

Identifying and monitoring extremist groups is essential. An excerpt from the above referenced *Rightwing Extremism* report (2009, April 7, n.p.) states that:

> (U//FOUO) DHS/I&A will be working with its state and local partners over the next several months to ascertain with greater regional specificity the rise in rightwing extremist activity in the United States, with a particular emphasis on the political, economic, and social factors that drive rightwing extremist radicalization.

Monitoring extremist groups requires the acquisition of intelligence. Acquiring intelligence requires, among other things, identifying group membership and their associates, and identifying their ideology and intentions. That requires electronic/technical surveillance and physical surveillance. One of the objectives of physical surveillance is recording photographs and moving video images of group members and their associates. Acquiring photographic images for intelligence purposes requires skillful manual clandestine photography. Photographing rural-based groups can require an ultra-long-range stand-off capability, the ability to photograph subjects from extreme distances.

THE BLURRED LINE SEPARATING INTERNATIONAL TERRORIST AND CRIMINAL ORGANIZATIONS

> The global situation today is such that one need not be too concerned about where the purely criminal threat ends and the terrorist threat begins, or visa versa–with each one finds the other in various forms and to a varied extent.

A circumstance making manual clandestine photography more important today than ever before are the increasingly blurred lines that separate purely criminal activity from terrorist activity. Criminals are a political, economic, and social detriment because of the nature of their predatory criminal activities, but the objective of terrorists is to destroy. Nevertheless, one cannot conveniently separate the threat presented by criminals and terrorists because they each commit crimes and each use terror tactics. Moreover, terrorist and criminal enterprises sometimes operate in collusion.

Although statistics fail to agree, an undeniable correlation exists between terrorist and criminal organizations. Some reports suggest a significant correlation while some suggest limited correlation. Any correlation between the two, however, gives cause for concern. More important than how many groups coordinate efforts are the consequences of cooperative efforts between terrorist and criminal organizations.

Antonio Maria Costa, Executive Director of the United Nations Office on Drugs and Crime, writing for the *Washington Post,* confirmed a relationship between drug lords, insurgents, and terrorists stating:

> Drug traffickers have a symbiotic relationship with insurgents and terrorist groups such as the Taliban and al-Qaeda. Instability makes opium cultivation possible; opium buys protection and pays for weapons and foot soldiers, and these in turn create an environment in which drug lords, insurgents and terrorists can operate with impunity. (Costa, 2007, April 25, p. A17.)

Terrorist organizations commonly use the financial rewards of crime to support their operations, as stated. Terrorist organizations not only exploit the monetary advantages of crime, but sometimes collusion between criminal and terrorist organizations exists, as stated. That terrorism presents a crime problem receives acknowledgment in *The Military Guide to Terrorism in the Twenty-First Century* (U.S. Army TRADOC G2 Handbook No. 1, 2007, August 15, p. 5-9) wherein it states:

> Terrorist operations require extensive financial support. The facility with which groups can obtain and move funds, procure secure bases, and obtain and transport weaponry determines their operational abilities and the level of threat that they pose. The international nature of finance, the integration of global economies, and the presence of terrorists in the illegal economies of slaves, drugs, smuggling, counterfeiting, identity theft, and fraud have aided this new independence from traditional sources of sponsorship and support.

The global situation today is such that one need not be too concerned about where the purely criminal threat ends and the terrorist threat begins, or visa versa–with each one finds the other in various forms and to a varied extent. Terrorists use crime to finance terrorist activities and organized criminals use terror to acquire and maintain power, to control and preserve their economic interests. One finds evidence of this in a news release issued by the Criminal Intelligence Service Canada (2007, August 17, n.p.) wherein it states that, "organized crime groups routinely use violence and intimidation to protect or expand their interests. In some cases this results in a direct threat to public safety."

Although some reports suggest limited collusion between criminal and terrorist organizations, all the evidence suggests it does occur and may be escalating. Addressing this concern is *The Military Guide to Terrorism in the Twenty-First Century* (U.S. Army TRADOC G2 Handbook No. 1, 2007, August 15, p. 5-4) wherein it states:

> Terrorist groups and other illegal sub-state organizations are rapidly becoming indistinguishable from each other. The increasing role of criminal activ-

> ity in financing terrorism, either in partnership or competition with traditional criminal activities, is making it very difficult, if not impossible, to clearly determine where one stops and the other begins.

Some terrorist organizations exploit the profits of crime to finance terrorist activities, and some terrorist organizations purchase weapons from criminal enterprises or exploit criminal organizations in other ways. For example, November 26, 2007, the *Washington Times* reported an apparent effort by Islamist terrorists (Afghan and Iraqi) to smuggle terrorist personnel and weapons into the United States using drug transport tunnels under the Mexico and United States border in Texas (USA). The weapons included antitank missiles, surface-to-air missiles, grenade launchers, and small arms. Reportedly, the intended purpose of the terrorist personnel and weapons was for an attack on Fort Huachuca in southern Arizona (USA), Fort Huachuca being the largest military intelligence-training center in the United States (Carter, S. A., 2007, November 26).

Further attesting to symbiotic relationships sometimes occurring between sponsors of terrorism and criminals are the 1985 negotiations that occurred between Libya's de facto leader Muammar Qadhafi and the United States street gang El Rukn. Those negotiations revealed that symbiotic relationships sometimes occur between terrorists and criminals even if the relationships are objective specific and therefore sporadic and temporary. Reportedly, "in 1985, the El Rukn gang reached out to the Libyan government and negotiated a deal: in exchange for $2.5 million [USD] . . . the El Rukns would unleash a massive terrorist and urban warfare campaign in the United States, targeting police stations, army bases, government offices, and an airliner" (MIPT Terrorism Knowledge Base, 2008, January 29, n.p., *El Rukns*).

The terrorist threat is real and carries with it a criminal threat. Proactive intervention is essential because, if ignored, terrorists will not fade into history. *The Military Guide to Terrorism in the Twenty-First Century* (U.S. Army TRADOC G2 Handbook No. 1, 2007, August 15, p. 5-1) reports that:

> There is every indication that the number and magnitude of attacks on the United States, its interest and its allies will likely increase." Predicting the nature, timing, or location of the next attack is beyond the scope of this report, however, the task force spotlights, "The most significant terrorist threat to the homeland today stems from a global movement, underpinned by a jihadist/Salafist ideology.

The National Alliance of Gang Investigators Associations (2005, p. 6), in a report titled *2005 National Gang Threat Assessment,* reports that:

> Many STG [security threat groups] inmates additionally have ties to terrorist groups, and those who do not may be susceptible to recruitment by terrorists. For example, 27 STG inmates at the Administrative Maximum Security Prison in Florence, Colorado [USA], represent al-Qaeda, the Islamic Resistance Movement (HAMAS), and the Palestinian Liberation Organization. Of these STG inmates, 18 have formal terrorist training.

When considering statistics that suggest limited interaction between terrorist organizations and organized crime syndicates or between terrorists and street gangs, keep in mind that, "Approximately 31 percent of law enforcement officials surveyed reported that their communities either denied the problem [of gangs], had no response, or expressed no interest in it. Several officials added that their communities did not respond to the gang problem until high-profile gang-related incidents and homicides escalated" (National Alliance of Gang Investigators Associations, 2005, p. 15).

Information of this nature leaves one wondering to what extent estimates understate rather than overstate the extent of affiliation between criminals and terrorists. If denial of a problem as visible as street gangs exists, there is reason to expect that denial exists relative to the less visible cooperation between criminals and terrorists.

Some terrorists live discretely in a community for years, appearing to embrace the local culture, before committing an act of terrorism. Uriel Rosenthal and Erwin R. Muller (2007, p. 59) confirm this, reporting that, "some [terrorists] are prepared to keep up the appearance of this culture and lifestyle for years and then to strike from within."

An undeniable and unsettling correlation exits between terrorists and organized criminals in spite of an inability to ascertain the extent of the correlation. One finds evidence of the correlation in many sources including *The Military Guide to Terrorism in the Twenty-First Century.* An excerpt from the manual states that, "Another aspect of the bombings [of commuter trains in Madrid, Spain, in March 2004] was the terrorist connection to crime and drug dealing in a network that spanned Morocco, Spain, Belgium and the Netherlands" (U.S. Army TRADOC G2 Handbook No. 1, 2007, August 15, p. 2-4).

THE PUBLIC'S LACK OF AWARENESS

> Most members of the public in America and many other countries do not realize the extent of the terrorist threat and the degree to which it places their quality of life at risk if permitted to go unchecked.

In some respects, social and legal pressure in countries such as the United States make protecting the public more difficult than perhaps it needs to be. Freedom is a precious thing that everyone should cherish. Unfortunately, in too many instances and seemingly so in America, too many people are complacent and assume freedom will always exist. Neither do many appear to understand that freedom requires sacrifice; freedom came at a high price and maintaining freedom requires diligent perseverance and sacrifice. Even the destructive terrorist attacks of September 11, 2001, appear to have faded from the collective memory of Americans.

It appears that many Americans take their freedom for granted. Neither do they appear to realize the potential for another terrorist attack of devastating proportions, on American soil. It appears that they also fail to understand that serial terrorist attacks can become a reality in America, attacks in the form of but not limited to vehicle bombs, suicide bombers, and chemical attacks. Perhaps this is because too many Americans failed to study history, too many are not aware of current events, and most Americans are not military veterans and even fewer are war veterans. Seemingly, while many Americans desire safety, they want safety without inconvenience.

Most members of the public in America and many other countries do not realize the extent of the terrorist threat and the degree to which it places their quality of life at risk if permitted to go unchecked. For purposes of security, government cannot publicly disclose much of the intelligence information it acquires. That is necessary but it leaves the public uninformed and, consequently, less supportive of counterterrorist efforts. Uriel Rosenthal and Erwin Muller (2007, p. 93) summarize the threat well in their book *The Evil of Terrorism: Diagnosis and Countermeasures.* They summarize the terrorist threat and the public's lack of awareness of that threat as follows:

> . . . only few people know how great the actual threat of international terrorism is. There are only a limited number of people who have an accurate picture of this threat. Governments, intelligence and security services, the police, the judicial authorities, the armed forces, and a small number of well-trained experts have a considerable knowledge. The population becomes aware of the threat only when there is a terrorist attack.

THE IMPORTANCE OF COUNTERING THE MANUAL CLANDESTINE PHOTOGRAPHY EFFORTS OF ADVERSARIES

> . . . a strong manual photography capability on the part of an adversary is less dangerous than the failure to understand the extent of their capability. Understanding the opposition's photographic capability is prerequisite to defending against it.

Law enforcement, intelligence agencies, and military special operations forces need a strong manual clandestine photography capability. Counterintelligence personnel need an understanding of manual clandestine photography to implement appropriate countermeasures. This is an important issue because unfriendly forces engage in, among other surreptitious activities, manual clandestine photography. One finds evidence of this at the website of the Central Intelligence Agency (2007, April 23, *Iraq's intelligence services*) wherein the CIA reports that, relative to the intelligence apparatus of the former Iraqi government:

> M13 was responsible for operational support services, such as lock-picking, *surveillance photography* [emphasis added], electronic eavesdropping, and counterintelligence functions at Iraqi embassies abroad. When a target was identified and approved for collection, M13 conducted the operation.

Further evidence that foreign intelligence agents employ manual clandestine photography is the Russian Federation Federal Law No. 5, *On Foreign Intelligence.* On January 10, 1996, Boris Nikolayevich Yeltsin, then Russian Federation President, endorsed the law. A portion of the law reads as follows:

> For the purpose of attaining the objectives of intelligence collection activity, the Russian Federation foreign intelligence organs are empowered to use information systems, video and audio recordings, *moving and still photography* [emphasis added], the downloading of information from technical communications channels, and other methods and means in line with the requirements posed by Paragraph 2 of this Article. (Pike, 1998, August 14, n.p.)

Further attesting to the long-standing need for counterintelligence personnel to understand manual clandestine photography is an excerpt from the School of the Americas (SOA) Study Manual LN324-91[9] (n.d., p. 59, *Study Manual LN324-91*). The excerpt reads as follows:

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9. The School of the Americas (SOA), established in 1946, closed in 2001. Replacing the SOA is the Western Hemisphere Institute for Security Cooperation (WHINSEC). WHINSEC, a United States Department of Defense training facility located at Fort Benning in Columbus, Georgia (USA), provides Spanish-language training for Latin American military and law enforcement personnel. While the training curriculum of the now closed SOA received criticism from some people, one must contemplate the scope, plan, and purpose of the SOA relative to the political situation during that period, a period that included the Cold War and communist expansionism. The World Factbook (2008, March 20, n.p., *Cuba*) reports that, "Cuba's Communist revolution, with Soviet support, was exported throughout Latin America and Africa during the 1960s, 1970s, and 1980s." Today, there are some people encouraging closure of WHINSEC even though the school's scope, plan and purpose has changed, the school welcomes drop-in visitors, and all students receive human rights instruction.

E. Imagery Intelligence
   2. Manual Photography by an Agent:
      a. Is the personnel conscious of this kind of threat?
      b. What physical security precautions are taken to protect themselves against this threat?
      c. How vulnerable is the installation?
      d. Are the guards aware of this threat and know how to prevent it?

Among the essential investigative and espionage tools of the various government agencies, both friend and foe, is manual clandestine photography. Stated earlier, a strong manual photography capability on the part of an adversary is less dangerous than the failure to understand the extent of their capability. Understanding the opposition's photographic capability is prerequisite to defending against it. Therein one finds the secondary value of the information presented in this book. This book contributes to countermanual clandestine photography, countersurveillance, and counterintelligence. Stated earlier, it is unlikely that an adversary will demonstrate a manual clandestine photography capability exceeding what this book presents.

Chapter 2

CAMERAS AND LENSES FOR MANUAL CLANDESTINE PHOTOGRAPHY

The camera is merely an extension of my eye. (Henri Cartier-Bresson, 1908–2004)

INTRODUCTION

Photography is the recording of still images while videography is the recording of moving video images. Nevertheless, frequently, for purposes of brevity the authors use the term photography as a blanket term embracing both single image photography and videography. For example, when discussing and illustrating a digital single-lens reflex (DSLR) camera technique for the recording of single images (still pictures), the reader should envision the possibilities when using the technique with the camera in high definition (HD) video mode.

Throughout this book, unless stated otherwise, when the authors speak of maximum photographic range, they are referring to the distance from which recording detail such as recognizable images of people's faces and legible vehicle number plates (license plates) is possible. More than anything else, subject identification and legible vehicle number plates are their criteria for usable photographic images whether in the form of still pictures or moving video images. An excerpt from the FBI Forensic Science Communications manual validates this criterion. The excerpt states that, "The successful capture of images sufficient for identification of depicted individuals and/or objects (e.g., license plates) will require close attention to the selection and appropriate use of equipment" (*Forensic Science Communications, Vol. 4,* No. 2, 2002, April, n.p., *Standards and Guidelines: Surveillance Photography SOP*).

This chapter examines the cameras and lenses that are appropriate and in some instances essential for manual clandestine photography (i.e., digital cameras, camcorders, telephoto lenses, and telescopes that are suitable for use as a telephoto lens). The next chapter, which is a continuation of this chapter, introduces essential accessories. Many accessories are commercially available but several specialized items require custom fabrication. Manual clandestine photography is a complex and specialized application of photography that often requires supporting apparatus that general photographers do not need.

The information in this chapter and the next provides a foundation to support subsequent discussion of field application methods.

DIGITAL SINGLE-LENS REFLEX CAMERAS

> When purchasing a digital single-lens reflex camera one is buying more than just a camera. One is buying into a system that he, she, or the agency must thereafter live with. Canon and Nikon more than any other camera manufacturer offers a comprehensive assortment of cameras, lenses, and accessories.

Introduction

Modern digital cameras and camcorders are sophisticated computers that feature a lens system to project an image onto an electronic light sensitive image sensor. Moreover, lenses for modern digital single-lens reflex cameras and many camcorders contain a computer chip that permits electronic communication between the camera and lens for aperture control, auto-focus, and image stabilization if the lens has the latter feature. Canon uses the term image stabilization (IS) while Nikon uses the term vibration reduction (VR). In this book, the authors use the term image stabilization, applying the term generically with no intended reference any particular brand of camera.

The term *single-lens reflex* (SLR) applies to a class of camera wherein the photographer views the subject through the same lens that provides the image captured by the image sensor when taking a picture. When speaking and writing, photographers frequently refer to digital single-lens reflex cameras by initializations. Common initializations include *DSLR, D-SLR, dSLR,* and *digital SLR.* All the initializations are correct. For the purpose of consistency, throughout this book the initialization DSLR is used.

Digital single-lens reflex cameras (DSLRs) feature a *reflex mirror* (reaction mirror) that intercepts the incoming light from the lens and diverts it to the

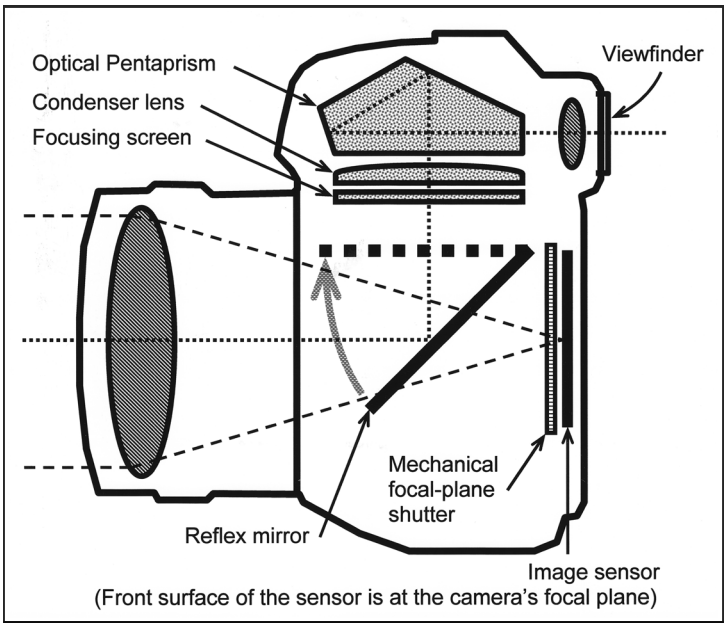

Figure 2-1. The digital single-lens reflex (DSLR) camera contains a reflex mirror featuring an up and down position. In the down position, the mirror diverts the incoming light through the optical pentaprism to the eyelevel viewfinder. With the mirror in the up position, light passes directly from the lens to the camera's image sensor. When taking a picture, the mirror flips up, the focal-plane shutter activates thus exposing the image sensor, and then the mirror returns to the down position. This process occurs every time the photographer takes a picture unless using the camera in the mirror lock-up mode.

camera's eyelevel viewfinder. The viewing system is such that the photographer sees what the lens sees. The photographer also sees what the image sensor will record once activating the shutter (see Figure 2-1).

The lens on the cameras providing both the viewfinder image and the image that the sensor will record is the distinguishing feature of a single-lens reflex (SLR) camera. Moreover, reflex viewing is an essential feature of interchangeable lens cameras. The photographer must see what the lens sees when using a wide-angel, normal perspective, or telephoto lens. Reflex viewing permits the photographer to correctly compose and critically focus the image. Photographers refer to reflex viewing also as through the lens (TTL) viewing.

Digital single-lens reflex (DSLR) cameras feature a liquid crystal display (LCD) monitor. Nevertheless, the LCD monitor of DSLR cameras does not work for framing and focusing purposes but permits examining the picture afterwards, as well as serving other functions. The exception is DSLR cam-

eras featuring a Live View mode; they permit framing of the subject using the LCD monitor.

The primary benefits that DSLR cameras provide clandestine photographers include but are not limited to the following:

- Reflex viewing system. Through the lens (TTL) viewing permits the surveillance specialist to see what the lens sees.
- Through the lens (TTL) metering. With TTL metering, the camera's internal light meter measures the intensity of the light reaching the electronic image sensor. The surveillance specialist uses the information to achieve proper exposure without the need to make compensatory calculations. TTL metering eliminates the need to make compensatory exposure calculations when using filters, mirror lenses, and when doing afocal and eyepiece projection photography. TTL metering is a valuable feature. Consider, for example, that the mirrors in a Schmidt-Cassegrain telescope (SCT) cause about a 2/3 stop loss of light; the mirrors cannot reflect more than about 85 percent of the light striking their surface. *Note:* SCT is an initialization for Schmidt-Cassegrain telescope.
- Lens interchangeability. DSLR cameras accept a wide variety of interchangeable lenses (e.g., wide angle; normal perspective; telephoto; zoom/variable focal length; macro/close-up; and perspective control/tilt-shift). Additionally, the surveillance specialist can camera-adapt refracting telescopes and Catadioptric telescopes to use as low cost telephoto lenses or as ultra high-magnification telephoto lenses.
- Fast (large aperture) telephoto lenses are available for DSLR cameras.
- Numerous accessory items are available for DSLR cameras.
- Large image sensor. Full-frame and crop-sensor DSLR cameras feature image sensors much larger than the sensors in digital compact cameras and digital bridge cameras. Large image sensors provide higher quality images. Additionally, several full-frame and crop-sensor DSLR cameras feature high-definition (HD) video capture. That feature coupled with the large image sensor permits high-quality high-magnification videography during daylight hours and under low-light conditions with and without an image intensifier night vision device.
- Limited shutter lag. DSLR cameras feature limited shutter lag, shutter lag being the time between depressing the shutter release button and the shutter activating. Nevertheless, the time required for an autofocus lens to achieve focus lock can result in unacceptable lag when photographing a fast moving situation or a situation featuring a brief

so-called decisive moment. Focus lock delay often is problematic when photographing under low-light conditions and when photographing through heavily tinted vehicle windows.

- Dynamic range. DSLR cameras feature considerable dynamic range. Canon defines dynamic range as, "The ability of the camera's CCD [image sensor] to capture a full range of shadows and highlights" (Canon UK, 2009, n.p.). Dynamic range is important when photographing under low-light conditions. Great dynamic range is good for evidentiary and intelligence images that must contain maximum detail, even in shadow areas. Dynamic range also permits under exposing during extreme low-light photography to achieve a suitably fast shutter speed and later salvaging the images using a graphics-editing program featuring an appropriate RAW processor. When under exposing to increase shutter speed, shoot to RAW!
- Record high-definition moving video images. Stated above, some full-frame and crop-sensor DSLR cameras record moving video images and that technology is advancing rapidly. For manual clandestine photography, the ability to record high-definition moving video images using a DSLR camera with any lens or telescope the camera accepts is significant. The surveillance specialist can now record high-definition moving video images from distances that exceed the capability of conventional camcorders even when used by means of afocal coupling. The large image sensor of the DSLR camera permits recording moving video images using high-magnification lenses without a small dimension image sensor reducing the angle-of-view to an intolerable extent.
- DSLR cameras are reasonably user friendly with the result being that field agents not well versed in photography can record quality photographic image under normal lighting conditions. The user-friendly nature of this class of camera minimizes training time and reduces the need for advanced knowledge of photography for short- to intermediate-range surveillance photography under adequate lighting conditions. Advanced surveillance photography, of course, requires a high level of technical expertise. Extreme low-light photography, night vision photography, and high-magnification photography fall into the category of advanced surveillance photography requiring advanced skill.
- DSLR cameras feature low cost of operation.
- With a DSLR camera, the surveillance specialist can record numerous still images before a recording media (memory card) change is neces-

sary. The number of images a memory card holds depends on variables such as the capacity of the card, image quality, image size, and the image area settings used.

- DSLR cameras permit instant scrutiny of results. The surveillance specialist can view the images on the camera LCD monitor to verify successful image capture. When photographing directly to a laptop computer, the specialist can immediately scrutinize the image on the computer display screen, which is more efficient than viewing images on the small LCD monitor of the camera.
- The surveillance specialist can delete undesirable images to make room on the memory card for subsequent pictures. Sometimes, for legal reasons, deleting images is unacceptable.
- Once transferring images from the camera to a laptop computer, the surveillance specialist can immediately process them and then electronically transmit them to a distant location. From the field, the specialist can transmit images by means of wireless transmission technology.
- The surveillance specialist can transfer images from the camera to a computer or a portable hard drive to protect against image loss. Digital technology makes storing digital images easy and efficient.
- DSLR cameras permit post photography image editing using an appropriate graphics-editing program.
- DSLR cameras enable the surveillance specialist to change the ISO setting and program the camera to accommodate different types of light as circumstances change (e.g., auto, daylight, shade, cloudy, tungsten, fluorescent, and flash). Previously stated, most DSLR cameras are relatively user friendly.
- Many modern DSLR cameras feature exceptionally high maximum ISO sensitivity and high ISO noise reduction technologies, which enables them to perform well in low-light situations. At the time of this writing, DSLR cameras are available featuring expanded ISO sensitivities of 25,600 and 102,400. In the future, DSLR cameras probably will offer higher maximum ISO sensitivity and improved noise reduction technologies.

Digital single-lens reflex (DSLR) cameras feature a mechanical focal-plane shutter located in front of the electronic image sensor (refer back to Figure 2-1). The image sensor is at the focal-plane and thus the reason for the term *focal-plane shutter.* A focal-plane shutter makes lens interchangeability practical and more economical by eliminating the need for each lens to contain a shutter mechanism. Unfortunately, the mechanical action of the reflex-mirror, the focal-plane shutter, and the drive motor creates vibration. More-

over, DSLR cameras are noisy and emit a distinctive sound detectable outdoors from 91.44 meters (100 yards) or more.[1]

Important! When purchasing a DSLR camera one is buying more than just a camera. One is buying into a system that he, she, or the agency must thereafter live with. For that reason, consider not only camera brand and operating features, but also scrutinize the system of which the camera is a part. Carefully evaluate the lenses and accessories that are available for the camera. This is one reason that Canon and Nikon dominate the DSLR camera market–they both offer a comprehensive assortment of lenses and accessory products.

Full-Frame Digital Single-Lens Reflex Cameras

Full-frame digital single-lens reflex (DSLR) cameras feature an image sensor measuring 36 x 24 millimeters or very close to those dimensions. Full-frame DSLR cameras satisfy the needs of professional photographers and advanced amateur photographers. Name brand cameras in this category are comparatively expensive, but they are high quality and high performing. Larry Loh, writing for CNET Asia, confirms the benefits of a full-frame image sensor relative to image quality and camera performance during low-light photography. Mr. Loh (2008, n.p.) explains that, "The larger image sensor of a dSLR means it has less electronic noise, and therefore can be used at higher ISO values without producing pictures with noise. . . . The bigger sensor of dSLRs also means better image quality."

It is true, generally speaking, that the larger the dimension of the image sensor the better the image quality and, therefore, the better suited the camera is for low-light photography. Nevertheless, image sensors measuring less than 36 x 24 millimeters do provide excellent image quality. In both the prosumer[2] and professional categories, one finds Canon and Nikon full-frame and crop-sensor DSLR cameras.

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1. During physical surveillance, the surveillance specialist sometimes moves in by foot becoming close enough to the subject to listen to his or her verbal conversation with another person. Photographing from that close distance using a DSLR camera creates a high risk of detection. If photographing within hearing distance is necessary use a quiet camera such as a digital compact or digital bridge camera. Alternatively, record pictures only when masking sounds exist in the area. Some DSLR cameras feature Live View mode, which is comparatively quiet. That feature presents possibilities. Be sure that the light emitted by the LCD monitor does not alert the subject, and never forget to deactivate the flash.

2. The term prosumer is an acronym, the result of blending parts of the words *professional* and *consumer: pro*fessional + con*sumer* = prosumer. A prosumer is an advanced amateur photographer who needs many of the features found on professional grade cameras. Prosumer cameras satisfy the needs of advanced amateur and professional photographers by providing many professional features while being less costly than professional grade cameras.

Crop-Sensor Digital Single-Lens Reflex Cameras

Crop-sensor digital single-lens reflex (DSLR) cameras feature an image sensor measuring less than 36 x 24 millimeters. The Canon APS-C sized crop-sensor measures 14.9 x 22.3 millimeters while the Nikon DX CMOS crop-sensor measures 15.8 x 23.6 millimeters. In comparison to full-frame DSLR cameras, crop-sensor DSLR cameras are smaller, weigh less, and they cost less.

Crop-sensor DSLR cameras perform well and no reasons exist to reject them as a tool for manual clandestine photography except when reduced field-of-view will present a problem. Crop-sensor cameras feature a focal length conversion factor (crop factor) according to the dimensions of the image sensor, this issue discussed later in this chapter. *Focal Length Conversion Factors Pertain to Angle-of-View, Not Magnification!*

Camera Performance at Exceptionally High ISO

At the time of this writing, Canon and Nikon offer DSLR cameras featuring maximum ISO of 25,600 and 102,400. The Canon EOS 5D Mark II DSLR camera, at ISO 25,600, performs well in both the single image and video mode (refer to Figure 4-46 in Chapter 4). When viewing that image, keep in mind that the criterion of a clandestine photographer often is very different from that of photographers in other genre. For example, image quality unacceptable to a wildlife photographer may be acceptable to a surveillance specialist.

COMPACT DIGITAL CAMERAS

> Forget the pixel count and look for the best features in these miracles of miniaturization! (Resnick, 2009, March 11, n.p.)

Modern compact digital cameras, referred to as "Ultra Compact" digital cameras, "Pocket Cameras," and "Point-and-Shoot" cameras are highly sophisticated and offer many valuable features. Likely they would be classified as spy cameras had they existed during World War II and much of the Cold War (refer to Figure 1-5 in Chapter 1). They are becoming increasingly capable and in some cases smaller with the 10MP Kodak EasyShare Mini, for example, being the size of a credit card although thicker.

In most instances, the surveillance specialist does not use a digital pocket camera to record still images or moving video images. Nevertheless, cameras in this class are a suitable option in some instances. Consider, for exam-

ple, that a pocket camera implies "amateur" which can facilitate a pretext cover–few people expect a professional surveillance specialist to use a digital pocket camera.

Compact digital cameras are small and easily concealed, easy to use inconspicuously, and they record quality images when lighting is adequate. Moreover, this class of camera is so common that one can openly use them in many instances without arousing suspicion. Attesting to the prevalence of compact digital cameras and therefore their unobtrusive nature is an excerpt from the Digital SLR Guide (2009, n.p.) titled *What Is a Digital SLR Camera?*

> Many consumers are much more familiar with compact digital cameras, since these models have flooded the marketplace. . . . Like cell phones, it's hard to walk down the street these days without seeing someone snapping a photo. Digital SLR cameras are far less common, and up until 2005 were really only used by professionals.

Some although not all compact digital cameras are suitable for short to moderate range clandestine applications such as photographing subjects inside and outside of buildings, recording still images and moving video images (see Figures 2-2 to 2-4b and refer ahead to Figure 2-36 to view the Canon PowerShot SX210 IS digital pocket camera used to record the following images).

In addition to being small, concealable, and easy to use discreetly, high-definition movie recording is becoming a characteristic feature on compact digital cameras. The movie mode (motion picture mode) of digital pocket cameras sometimes provides the means to record moving video images of a subject without appearing to be doing so–activate the camera in the video mode and set it aside. Let it appear to be a still camera sitting unused. Alternatively, when working with a partner, the surveillance specialist can "appear" to be showing the second person images on the LCD monitor while actually photographing the subject. If the pretext involves showing the second person pictures of, for example, a child's recent birthday party or a house one may soon purchase, the camera should contain a few suitable images to complete the pretext should somebody become concerned and make inquiry. *Always deactivate the flash!*

Compact digital cameras also work for long-range and ultra-long-range terrestrial photography by means of afocal coupling (i.e., photographing through the eyepiece of a secondary optical system). The eyepiece may be on a spotting scope, telescope, or on a telephoto camera lens.

Two benefits of using a compact digital camera for afocal photography is their limited physical size and weight and lack of mirror slap (mirror flip) induced vibrations characteristic of DSLR cameras. In some instances, this

Figure 2-2. The 14.1 megapixel Canon PowerShot SX210 IS digital pocket camera featuring a 5-70mm f/3.1-5.9 zoom lens permitted recording an overview of the premises and then zooming in on the subject to record a close-up view. This camera features a 35mm equivalent focal length of 28-392mm relative to angle-of-view (not relative to magnification). *Upper image:* One frame from the moving video images recorded with the camera in the movie mode also called motion picture mode. *Lower image:* Full-zoom image recorded with the camera in the normal single-image picture-taking mode.

class of camera is well suited for long-range and ultra-long-range night vision photography. The Monocam™ night-vision camera system[3] designed to couple an image intensifier night vision device with the Olympus Stylus Tough-8010 compact digital camera performs well for this purpose (refer to Figures 5-15 and 5-32 in Chapter 5).

During ultra-long-range night vision photography using a high-magnification telescope by means of afocal coupling, the compact camera's lack of mirror slap (mirror flip) enhances image quality. Most compact cameras feature an electronic shutter or combination electronic/mechanical shutter resulting in little to no vibration when taking a picture. Moreover, the shutters are quiet.

3. Morovision Night Vision, Inc. markets the Monocam™ night-vision camera system (www.morovision.com).

Figure 2-3. Video images recorded from the balcony using the 14.1 megapixel Canon PowerShot SX210 IS digital pocket camera. The camera's 5-70mm zoom lens permitted recording an overview of the premises and then zooming in on the subjects. *Method:* Camera in movie mode also called motion picture mode.

A detriment to using compact digital cameras for manual clandestine photography is shutter lag, which can prevent photographically documenting a brief decisive moment. Another detriment is the small size image sensor, which diminishes field-of-view during afocal photography. The Olympus Stylus Tough-8010 compact digital camera, for example, with its 1/2.33″ CCD image sensor features a 5.6x focal length conversion factor meaning that angle-of-view diminishes by that amount. These are not problems, just limitations, and all cameras suffer limitations. The surveillance specialist selects a camera according to case specific needs with camera capabilities and limitations influencing the choice.

Figure 2-4a. *Camera-to-subject distance:* 110.64 meters (121 yards). The lower image is a cropped portion of the upper image. This image recorded using the 14.1 megapixel Canon PowerShot SX210 IS digital pocket camera in the movie mode also called motion picture mode. This is a single frame extracted from the moving video images.

CELL PHONES

Many of today's cell phones contain a camera that records still pictures or moving video images, or both. Additionally, camcorders are available that appear to be a cell phone. In some short-range situations a cell phone camera is a comparatively detection free way to record still photographs or mov-

Figure 2-4b. *Camera-to-subject distance:* 110.64 meters (121 yards). This image recorded using the 14.1 megapixel Canon PowerShot SX210 IS digital pocket camera in the single-image mode. Compare the image detail featured in this versus the previous illustration. *ISO:* 200. *Exposure time:* 1/500 second. *Aperture (f-ratio):* f/5.9. *Time of day:* 2:45 p.m. *Lighting:* Overcast. Clearly, although the movie mode provides the benefit of recording subject activity the single-image mode records better detail.

Figure 2-5. The surveillance specialist photographed these subjects through glass using a cell phone camera. The specialist was inside the restaurant seated at a table and the subjects occupied the outdoor patio area. Because the subjects are backlit by bright daylight, the specialist framed them in a way that excluded as much of the bright exterior light as possible. Image courtesy of Detective Darin Fredrickson.

ing video images of a subject (see Figure 2-5).

Cell phones are common and attract little attention. For that reason, a surveillance specialist using a cell phone to record photographic images tends to go unnoticed. Depending on circumstances, the specialist may use the cell phone camera as a short duration primary camera or to record backup images. When used to record backup images, the primary camera usually is a concealed high-definition camcorder. Alternatively, as a high-definition camcorder operates the specialist may record cell phone images for immediate transmission to headquarters by means of instant messaging for real time analysis.

In comparison to a conventional camcorder, video camera cell phones do not perform as well in low-light situations, recording duration is shorter, the optics are not as good, and most do not feature image stabilization. The quality of still images a cell phone camera records do not compare with those recorded by a quality digital pocket camera and certainly do not compare with DSLR camera images. Nevertheless, for many clandestine applications the photographic capabilities of cell phone cameras is adequate.

Technology is advancing rapidly. At the time of this writing, the photographic capabilities of cell phones serve a useful purpose relative to manual clandestine photography and videography and their performance predictably will continue to improve.

SHUTTER LAG–SHUTTER LATENCY

> The time from when you press the shutter release button (i.e. the trigger) until the camera actually takes the photo is known as total shutter lag. Total shutter lag is the combination of two processes at work: the autofocus lag and the shutter release lag. (Hass, C., 2008, n.p.)

When the surveillance specialist observes critical activity of a fleeting nature and depresses the camera's shutter release button to photograph it, the shutter must activate instantly. A one-quarter to one-half second or more shutter lag can result in failure to record the critical event. With digital compact cameras and digital bridge cameras, shutter lag can be as short as one-tenth of a second to one second or more. Such delays are excessive when attempting to photograph an important decisive moment such as one person passing something to another during a "brush" encounter in a public location. Realize that an event can consist of a series of intermittent but important decisive moments.

Shutter lag (shutter latency) exists with all digital still cameras, but it is most prevalent with digital compact cameras and digital bridge cameras.

Figure 2-6. With the digital single-lens reflex camera in the mirror lock-up mode and the lens in manual focus mode, shutter lag is virtually nonexistent. The surveillance specialist operates the camera using the remote release in her left hand, selecting exposures while observing the subject through the Leupold Mark 4 12-40x60 Tactical Spotting Scope. The specialist placed an antireflection device (ARD) on the spotting scope illustrated here. When camera-to-subject distance is limited, place an ARD and suitable LensCoat™ cover on the telephoto lens. Photograph by Jimmie Marler.

Digital single-lens reflex (DSLR) cameras usually feature minimal shutter lag, especially when using the camera in manual mode. Additionally, shutter lag is almost nonexistent when using a DSLR camera in the mirror lock-up mode with lens set for manual focus. A DSLR camera in full automatic mode frequently features shutter lag sufficient to prevent recording critical decisive moments, the lag being an auto-focus issue. Focus lock delay is most problematic when photographing through heavily tinted vehicle windows and when photographing under low-light conditions.

While shutter lag is minimal with modern DSLR cameras, in most instances, the time required for auto-focus lock can create an unacceptable delay and often does, especially when photographing through the tinted windows of a surveillance vehicle, as stated. When photographing under circumstances where shutter lag may present a problem, focus manually. Additionally, if necessary, mount the camera to a stable support and use the mirror lock-up feature, operating the camera using a remote shutter release. That method eliminates the time required for auto-focus lock and for the mirror to change position when taking a picture. When using the camera's mirror lock-up feature, observe the subject through a binocular or spotting scope

and operate the camera using a remote release (see Figure 2-6).

The shutter lag characterizing digital compact cameras and digital bridge cameras continues to be troublesome even though the cameras are improving in that respect. Calvin Hass (2008, n.p.), writing to the issue of shutter lag explains it as follows:

> One of the most frustrating problems some people run into with digital cameras is the characteristic known as shutter lag. How many times have you waited for the right moment to take a shot, only to spend the next second waiting for the camera to take the picture, if at all? Meanwhile, your perfect shot has vanished from view. This is shutter lag. . . . The time from when you press the shutter release button (i.e., the trigger) until the camera actually takes the photo is known as total shutter lag. Total shutter lag is the combination of two processes at work: the autofocus lag and the shutter release lag.

RECORDING MEDIA–MEMORY CARDS

The surveillance specialist must use memory cards compatible with the camera, use high quality cards, and use cards featuring adequate capacity and fast read/write speeds. Photographers who shoot in the RAW format require high capacity memory cards because RAW files are large and quickly fill a memory card. Photographers who shoot in JPEG format do not fill memory cards as quickly.

Some surveillance specialists use high-capacity memory cards because they can record more images before replacing the card is necessary. Other specialists use lower capacity memory cards and replace them frequently. They replace cards frequently to minimize the number of lost images should the card become defective, lost, or captured. Alternatively, some specialists use high-capacity memory cards with no intention of using their full capacity; they replace cards frequently while photographing. They use high-capacity cards in case they need the extra capacity when photographing a fast moving situation that provides no time for card replacement.

Keep used and unused memory cards in a digital media storage wallet, also called a card safe and card case. To avoid confusion and the mixing of used and unused memory cards, in the case, place unused memory cards face up and used cards face down. Alternatively, use two conspicuously different card cases, one for unused cards and the other for used cards.

LENSES SUITABLE FOR MANUAL CLANDESTINE PHOTOGRAPHY

> A telephoto lens is technically defined as a lens longer than the standard focal length of 50mm. As such, lenses with focal length of 85mm and above can be classified as telephoto lenses. (Nelson, 2002, n.p.)

Introduction

Regardless of their design, all photographic lenses and telescopes focus light rays to form an image. Modern photographic lenses and telescopes feature various optical designs and innovations to minimize image-degrading aberrations. Inside the camera, an electronic image sensor records the image created by the lens. The longer the focal length of the lens, the larger the size of the image the lens creates. When focal length increases but image sensor remains constant the angle-of-view decreases; focal length and image sensor size work together to determine angle-of-view.

The difference between a nontelephoto lens and a telephoto lens is a matter of focal length. Moreover, the focal length of a telephoto lens determines its classification such as short, medium, super, or ultra telephoto. Unfortunately, the classifications are not standardized. Nevertheless, relative to lenses for full-frame digital single-lens reflex (DSLR) cameras most photographers and camera lens manufacturers agree on the following imprecise classifications:

- Short telephoto lenses: 85 to 100 millimeters.
- Medium telephoto lenses: 100 to 300 millimeters.
- Super telephoto lenses: 400 to 1,000 millimeters.
- Ultra-telephoto lenses: Focal lengths greater than 1,000 millimeters. At the time of this writing, no camera manufacturer makes an ultra telephoto lens. When extreme magnification is required, clandestine photographers use high-magnification telescopes.

In addition to the above telephoto lens classifications that are, as stated, imprecise, photographers commonly classify camera lenses as being *short, moderate,* or *long.* Wide angle and normal perspective lenses feature a short focal length–they are *short* lenses. Telephoto lenses feature a long focal length–they are *long* lenses. Between the two extremes are *moderate* lenses.

Stated earlier, the longer the focal length of a lens the larger the size of the image it creates. Naturally, recording adequate detail of a distant subject requires using a longer focal length lens than is required to record similar detail of a closer subject (see Figure 2-7).

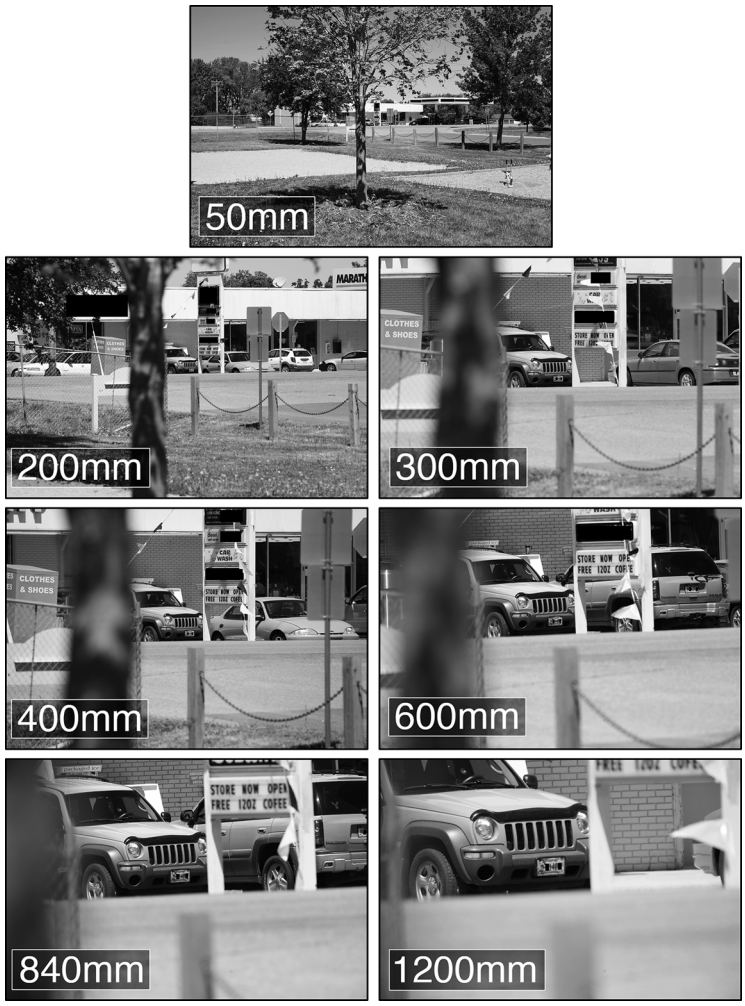

Figure 2-7. The longer the focal length of a lens the larger the size of the image it creates. The surveillance specialist recorded these comparative images from 115.21 meters (126 yards) using Canon lenses and teleconverters with the Canon EOS 5D full-frame digital single-lens reflex camera. The 1.4x and 2x teleconverters were used with the Canon EF 600mm f/4L IS USM super telephoto lens to obtain the 840mm and 1200mm focal lengths. *Note:* Shortly before manuscript submission Canon introduced the EF 600mm f/4L IS II USM super telephoto lens.

Maximum aperture (f-ratio) is the optical diameter of a lens relative to its focal length. Some lenses feature a large maximum aperture relative to focal length while some lenses feature a small maximum aperture relative to focal length. Large aperture lenses pass more light than small aperture lenses of

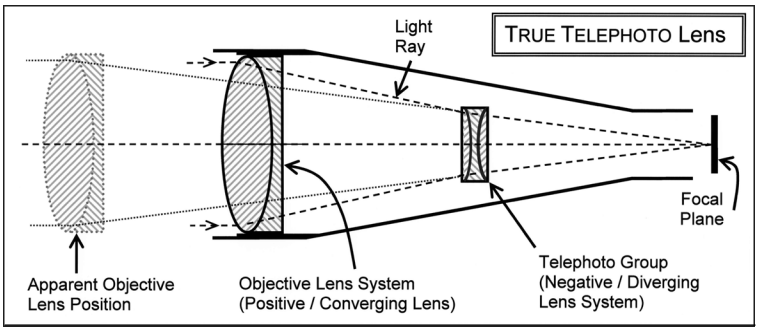

Figure 2-8. A true telephoto lens features a negative lens system called a *telephoto group* that moves the focal point further back. Moving the focal point farther back moves the *apparent* position of the objective lens further forward. The result is an *effective* focal length increase–the optical length is greater than the physical length.

the same focal length do. For example, the Canon 400mm f/2.8 telephoto lens is two stops faster than the Canon 400mm f/5.6 telephoto lens. The 400mm f/2.8 lens is fast while the 400mm f/5.6 lens is slow. Photographers refer to the ratio between aperture and focal length as the speed of the lens; lenses are *fast, medium,* or *slow,* this issue discussed under the subheading *Ultra-Fast Telephoto Lenses.*

True Telephoto Lens versus Long Focus Lens

True Telephoto Lens

> Prime (fixed) focals have the advantage of being fast (bright) and very high quality by virtue of the fact that they can be designed just for that focal length. (Hartley, 2005, n.p.)

A true telephoto lens features one fixed focal length. Additionally, the physical length is shorter than the focal length. Photographers refer to lenses featuring a fixed focal length as "prime lenses" or, simply, "primes." The Canon and Nikon 600mm f/4 super telephoto lenses are prime lenses, for example.

In its most basic form, a true telephoto lens consists of a lens tube containing a front positive (converging/convex) lens system and a rear negative (diverging/concave) lens system. The rear diverging/concave lens system is the *telephoto group.* In some respects, the telephoto group functions as a built-in tele-converter (see Figure 2-8).

A *true* telephoto lens features an *effective focal length* greater than the physical length, as stated. The difference between the effective focal length and

physical length exists because the telephoto group moves the focal point farther back thus moving the apparent position of the front (objective) lens forward. Moving the apparent position of the objective lens forward increases the *effective* focal length of the lens. For example, the Canon EF 600mm f/4L IS USM telephoto lens is optically 600 millimeters (23.62 inches) long but physically it is only 457.2 millimeters (18.0 inches) long. The difference between the physical length and focal length (optical length) is 142.75 millimeters (5.62 inches).

In reality, although modern telephoto lenses operate on the principle illustrated in Figure 2-8, their optical system is much more complex. For example, Canon's 800mm f/5.6 super telephoto lens features eighteen optical elements in fourteen groups. Nikon's 600mm f/4 super telephoto lens features fifteen optical elements in twelve groups.

Long Focus Lens

> In fact, a telescope is nothing more than a large telephoto lens. Or, if you prefer, a telephoto lens is nothing more than a small telescope. (Dembowski, n.d.)

When budget constraints prohibit buying Canon or Nikon super telephoto lenses, quality refracting telescopes are a suitable low cost alternative. Quality achromatic refracting telescopes perform well when used as a telephoto lens by means of the direct coupling (prime focus) method, also called prime-focus imaging. Apochromatic (APO) refracting telescopes perform even better. Using refracting telescopes the surveillance specialist can record quality telephoto images at a fraction of the cost required to own name brand super telephoto lenses. Nevertheless, refracting telescopes cannot provide image quality comparable to the image quality provided by Canon and Nikon super telephoto lenses.

Telescopes are optimized for direct viewing while Canon and Nikon telephoto lenses are optimized for photography. Additionally, achromatic refracting telescopes feature two lens elements and apochromatic (APO) refracting telescopes feature three lens elements (some feature four lens elements). On the other hand, the Canon 800mm f/5.6 telephoto lens features 18 lens elements in 14 groups. The Nikon 600mm f/4 telephoto lens features 15 lens elements in 12 groups. A refractor telescope featuring two or three lens elements should not and cannot provide image quality comparable to that of Canon and Nikon super telephoto lenses. Refractor telescopes perform well as telephoto lenses but they cannot perform better than their laws-of-optics limitations permit. The clandestine photographer uses refractor

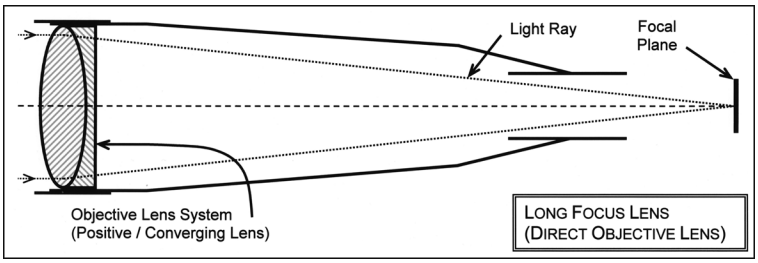

Figure 2-9. Refracting telescopes are a long focus lens. Their physical length is the same as their optical length. A long focus lens consists of a positive (converging/convex) lens system at the front of the optical tube with the rear of the tube featuring either a telescope eyepiece for direct viewing or a camera for recording photographic images.

telescopes in place of Canon and Nikon super telephoto lenses when budget constraints require making that compromise.

Refracting telescopes are long focus lenses. A long focus lens is a prime lens. One will hear long focus lenses referred to as *long focal length lenses* and *direct objective lenses*. Long focus lenses feature a physical length equal to the focal length; the lenses are optically and physically the same length.

A long focus lens consists of a positive (converging/convex) lens system at the front of the optical tube with the rear of the tube featuring either a telescope eyepiece for direct viewing or a camera for recording photographic images (see Figure 2-9). A quality long focus lens performs well when used as a telephoto lens for terrestrial photography. Moreover, they cost considerably less than name brand photographic telephoto lenses of comparable focal length. However, most refracting telescopes are not as fast as most super telephoto lenses of comparable focal length[4] and neither do they feature a variable aperture for light control, auto-focus, or image stabilization.

Many surveillance specialists desire to own Canon and Nikon super telephoto lenses, but they cannot afford them; such lenses are expensive even though their cost represents excellent value. Too often, specialists fail to realize that quality refracting telescopes perform well as a telephoto lens at a fraction of the cost of Canon and Nikon super telephoto lenses. Using a refracting telescope as a telephoto lens is easy by means of the prime-focus (direct

4. Relative to f-ratio versus focal length, compare the Canon EF 400mm f/5.6L USM Auto-Focus telephoto lens ($1,330 USD) with the 480mm f/6 Meade SERIES 5000 80 mm Triplet ED APO OTA refracting telescope ($800 USD). The telescope features 20 percent greater focal length and it is only 1/3 stop (specifically 0.1991 stops) slower in terms of comparative f-ratio. Sometimes, considering f-ratio in light of focal length and cost, the telescope may be the better choice or at least as good a choice. This Meade refracting telescope features fully multicoated FCD1 ED (Extremely Low Dispersion) glass.

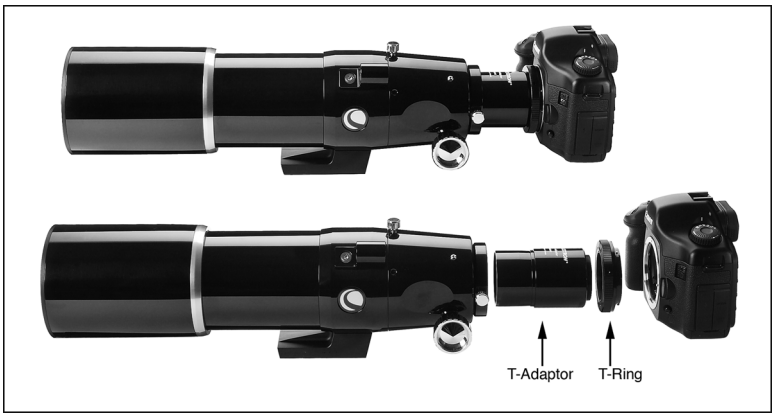

Figure 2-10. The 500mm f/6.25 Celestron Onyx 80EDF is a quality achromatic refracting telescope. This long focus lens performs well as a telephoto lens for clandestine photography by means of the prime-focus (direct coupling) method. This fully multicoated doublet (2 lens elements) optical system features Fluoro-ED glass that provides excellent image quality. The prime-focus method requires using the appropriate telescope T-Adapter and a T-Ring. Select a T-Ring compatible with the mount of the DSLR camera model in use. Should budget limitations exist, this lens is a suitable low-cost alternative to the expensive Canon and Nikon 500mm f/4 telephoto lenses although it is approximately 1 1/3 stops slower. A nice feature of this telescope is the permanently attached extendable lens shade.

coupling) method, also referred to as prime-focus photography (see Figure 2-10). Refracting telescopes are useful for daytime photography, for high ISO available light nighttime photography, and for photography using an image intensifier night vision device (refer ahead to Figure 2-37 and refer to Figure 4-13b in Chapter 4).

Refracting telescopes feature either an *achromatic* or an *apochromatic* (APO) lens system. Achromatic telescopes feature two lens elements called doublets. True apochromatic (APO) telescopes feature three or more lens elements. Astronomers refer to three-element apochromatic (APO) telescopes as triplets. When used as a telephoto lens for photography, apochromatic telescopes provide better image quality than achromatic telescopes do, although high-end achromatic telescopes perform well. Achromatic telescopes, as expected, cost less than apochromatic telescopes do.

Important: Avoid entry-level telescopes intended for children and be aware that some manufacturers and distributors advertise achromatic (doublets–2 lens elements) telescopes as apochromatic (APO) telescopes. Do not assume that a telescope features an apochromatic (APO) optical system (i.e., three or more lens elements) just because the promotional material identifies

Figure 2-11. Quality achromatic and apochromatic (APO) refracting telescopes are suitable low-cost alternatives to expensive Canon and Nikon super telephoto lenses when budget limitations proscribe purchasing name brand camera lenses. *Upper image:* Celestron Onyx 80EDF refracting telescope, 500mm f/6.25. *Center image:* Celestron 80ED refracting telescope, 600mm f/7.5. *Lower image:* Canon EF 600mm f/4L IS USM super telephoto lens. Featured here is the Canon EOS 5D digital single-lens reflex full-frame camera.

it as an APO or semi-APO. Check the specifications of the telescope because misleading advertising does occur.

Optical design, the number and shape of lens elements, the types of glass, the quality of antireflection lens coatings, and care during manufacturing determine the optical performance of a telescope. Optical design and materials determine how well a lens system minimizes chromatic and spherical aberration. Achromatic lens systems that feature two lens elements correct for two colors of light, red and blue, and they correct spherical aberration at one wavelength. Apochromatic lens systems featuring three or more lens elements correct for three colors of light and they correct spherical aberration at two wavelengths.

Agencies with budget limitations can use quality refracting telescopes as low-cost but suitable alternatives to the expensive Canon and Nikon super telephoto lenses. In terms of cost and performance, high-end refractor telescopes represent good value (see Figures 2-11 to 2-13, refer ahead to Figure 2-37, and refer to Figures 4-13a and 4-13b in Chapter 4).

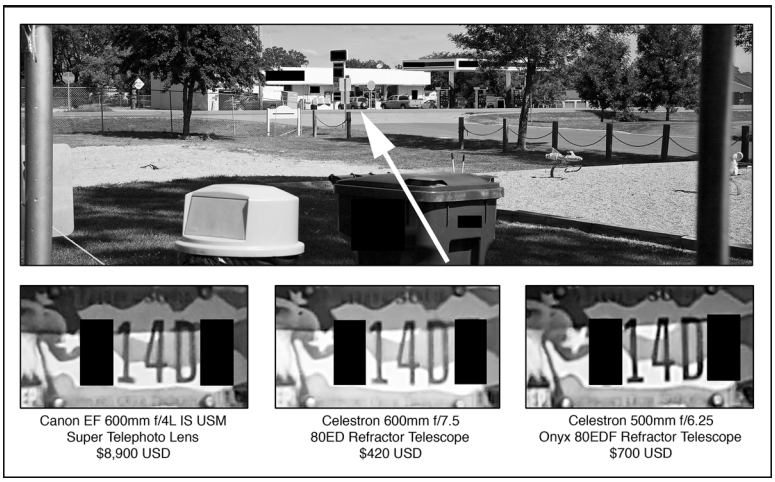

Figure 2-12. *Camera-to-subject distance:* 115.21 meters (126 yards). Quality refracting telescopes serve well as a low-cost alternative when budget limitations proscribe purchasing the superior performing Canon and Nikon super telephoto lenses. Overview image cropped top and bottom–ends not cropped. The arrow points to the vehicle bearing the number plate appearing in the lower images. Each number plate image is a cropped portion of images recorded from the same camera position using the same full-frame digital single-lens reflex (DSLR) camera. Comparing two low-cost but high-end achromatic (two lens elements) refracting telescopes of comparable focal length against the Canon EF 600mm f/4L IS USM super telephoto lens produced convincing results. When budget constraints prevent purchasing a Canon or Nikon super telephoto lens, consider using a quality refracting telescope by means of the prime-focus (direct coupling) method. Although they are doublets (Achromatic), these refracting telescopes feature Low Dispersion (ED) Glass and Celestron's Starbright XLT Coatings; they are fully multicoated. Apochromatic (APO) refracting telescopes (three lens elements) perform even better than achromatic telescopes do. The prices reflected above were the retail cost at the time of this writing so use them for comparison purposes only.

Comparison of the Canon and Celestron lenses was subjective and based on evaluation of field photographs. The authors made no comparisons using lens resolution charts and controlled lighting. Color and resolution produced by the Celestron lenses is good but not comparable to the Canon lens. Some color fringing occurs with the telescopes; apochromatic (APO) telescopes feature little color fringing.

During the writing of this book, unfortunately, Celestron discontinued production of the Onyx 80 EDF and 80ED Refracting achromatic telescopes. Fortunately, Meade® Instruments Corporation offers the Series 5000™ ED APO Refractings that are true Apochromatic triplet telescopes. Meade's Series 5000™ refracting telescopes feature three fully multicoated lens elements. Without doubt, these affordable telescopes provide superior

Figure 2-13. *Camera-to-subject distance:* 115.21 meters (126 yards). *Camera:* Canon EOS 5D digital single-lens reflex (DSLR) full-frame camera. The surveillance specialist recorded one image using the $8,900 (USD) Canon EF 600mm f/4L IS USM telephoto lens and the other image using the $420 (USD) 600mm f/7.5 Celestron 80ED refracting telescope (prices at the time of this writing). The telescope is an achromatic (two lens elements) featuring fully multicoated low dispersion (ED) glass. Which image is the result of which lens? Scrutinize the images before reading further. The specialist recorded the upper image using the Canon 600mm telephoto lens and the lower image using the Celestron 600mm telescope by means of the prime-focus (direct coupling) method. Clearly, refracting telescopes are a suitable alternative to expensive name brand super telephoto lenses when budget is a limiting factor. The Celestron telescope featured here is 1 2/3 stops slower than the Canon telephoto lens, which is a concern when low-light photography is necessary. The high ISO capability of modern DSLR cameras makes the slower lens speed less a detriment.

performance when used as a telephoto lens via the prime-focus (direct coupling) method. The Series 5000™ refractors feature a 480mm f/6, 700mm f/7, and 952.5mm f/7.5 telescope. The Meade website describes the Series 5000 telescopes as follows:

> Awesome visual and photographic performance in a very portable package. For crisp wide field observing and imaging, nothing can beat a true triple-

> element Apochromatic Refracting (APO). Meade Series 5000 ED APO Triplets are among the finest available optically at any price. Features a fully multi-coated triplet objective lens made from the highest quality ED (extra-low dispersion) glass for outstanding contrast and sharpness as well as near zero detectable chromatic aberration or "color fringing". . . . The scope is available as a standalone OTA [Optical Tube Assembly], or as a package with our new Series 5000 2″ enhanced diagonal and an aluminum carrying case. . . . Features a super precise dual speed 2″ Crayford focuser with 10:1 gear reduction for ultra fine focus control. . . . Bolts to standard photo style tripod with included bracket which has 1/4-20 mounting bolts.

The high-end achromatic refracting telescopes illustrated in this book are doublets featuring two lens elements made using Fluoro-ED glass. They are high performers as the two previous illustrations attest yet their performance cannot compete with that of the Meade Series 5000 telescopes which are true triplet apochromatic refractings. In addition to the Series 5000 telescopes featuring superb quality they are affordable. At the time of this writing, the Meade Series 5000 480mm f/6 telescope retails for less than one-eighth the cost of the Canon 500mm f/4 telephoto lens ($800 versus $6700 USD). This telescope retails for less than one-tenth the cost of the Nikon 500mm f/4 telephoto lens ($800 versus $8,500 USD).

High-end refracting telescopes perform well when used as a telephoto lens and they are inexpensive in comparison to comparable focal length name brand camera lenses (e.g., Canon and Nikon). The cost difference is extreme but in return for the savings, one must accept the following limitations:

- Slower lens speed (smaller f-ratio)
- No auto-focus
- No image stabilization (no vibration reduction)
- No aperture control (the lens contains no variable diaphragm)
- Lower image quality—not comparable to a conventional telephoto lens but excellent nevertheless

Slower Lens Speed. The smaller maximum aperture and therefore the slower speed of refracting telescopes in comparison to the faster telephoto lenses is not as great a concern today as it once was relative to low-light photography. Today, offsetting the slower speed of refracting telescopes is the high ISO capability of modern DSLR cameras in single-image and movie mode. The 500mm f/6.25 Celestron Onyx 80EDF refracting telescope is 1 1/3 stops slower than the Canon and Nikon 500mm f/4 telephoto lenses. Nevertheless, the expanded ISO sensitivity of 102,400 provided by the Canon EOS-1D Mark IV and Nikon D3s DSLR cameras offsets the slower

lens speed. When compared against ISO 100, expanded ISO sensitivity of 102,400 represents a light sensitivity gain of ten stops.

NO AUTO FOCUS. Refracting telescopes feature no auto focus. That is not a concern because, during manual clandestine photography using a high-magnification telephoto lens, the surveillance specialist usually focuses manually to achieve subject-specific focus.

NO IMAGE STABILIZATION (VIBRATION REDUCTION). Lack of image stabilization (vibration reduction) is not a detriment. That is because when the surveillance specialist uses high-magnification telephoto camera lenses with a tripod or other suitable support the image stabilization feature is off. An excerpt from the operator manual for the Canon EF telephoto lenses 300mm f/2.8 through 600mm f/4 reads: "Set the image stabilizer switch to off when you are taking pictures with a tripod. Even if the image stabilizer switch is set to on, the IS function does not operate because the electronic circuits in the lens automatically detect that a tripod is being used." The telescope's lack of image stabilization is not a concern.

NO APERTURE CONTROL. The absence of a diaphragm leaves the surveillance specialist unable to control light passage and neither can the specialist control depth of field. Alternatively, ISO and shutter speed controls exposure. The telescope always being at maximum aperture results in depth-of-field being too limited to compensate for focusing errors and, for that reason, accurate subject-specific focus is essential.

LOWER IMAGE QUALITY. High quality refracting telescopes perform well when used as a telephoto lens by means of the prime-focus (direct coupling) method, but major brand telephoto lenses such as Canon and Nikon perform better, as they should. Manufacturers of camera lenses optimize them for photography while the manufacturers of telescopes optimize them for direct viewing by means of an eyepiece lens. In his book *Digital SLR Astrophotography* (2007, p. 70), Michael Covington[5] confirms this stating that good telephoto lenses "have more elements and more sophisticated optical designs. If two or three lens elements were enough, even with ED glass, that's how camera makers would build telephoto lenses. It isn't."

In the final analysis, using refracting telescopes in place of name brand telephoto lenses means accepting limitations. However, the impressive performance of telescopes and their significantly lower cost makes the limitations acceptable.

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5. Covington, M. A. (2007). *Digital SLR Astrophotography.* New York: Cambridge University Press. Covington, M. A. (1999). *Astrophotography for the amateur* (2nd ed.). New York: Cambridge University Press.

Zoom Lens: Variable Focal Length Lens

> A zoom lens allows a choice from a continuous range of focal lengths. They are useful where you require a range of focal lengths but want the convenience of a single lens, whether for weight (only one lens), always being ready to take the picture or shooting in a dusty environment and you want to keep debris entering the camera to a minimum. . . . (Hartley, 2005, n.p.)

Variable focal length lenses, commonly referred to as zoom lenses, offer a range of focal lengths in one lens. A zoom lens being several lenses in one offers the convenience of instantly selecting a focal length that is most appropriate for the circumstances. That is a desirable feature for manual clandestine photography because it is important to have enough magnification without having too much. As magnification increases, field-of-view decreases. Moreover, when using a zoom lens, the surveillance specialist can use the shortest focal length to record an overview of the scene and then select a longer focal length to record detail.

Zoom lenses have improved considerably over the years with today's models being excellent (refer to Figure 4-46 in Chapter 4). Nevertheless, prime versus zoom lens tradeoffs exist, tradeoffs such as but not limited to the following.

- A prime lens usually costs less than a comparable focal length zoom lens. The exception is fast prime lenses, which are expensive.
- Prime lenses tend to be faster than comparable focal length zoom lenses; prime lenses tend to feature a larger maximum aperture, a larger f-ratio. Canon and Nikon both offer a 200mm f/2 prime lens but their fastest zoom lens with a maximum focal length of 200mm is f/2.8, one stop slower.
- Prime lenses generally provide higher quality images than comparable focal length zoom lenses do. In his book *Digital SLR Astrophotography,* Michael Covington (2007, p. 72) addresses this issue explaining that, "A zoom lens, even a high-technology zoom lens from a major manufacturer, is designed to be tolerable at many focal lengths rather than perfect at one."
- The auto-focus feature of a prime lens usually functions quicker than the auto focus feature of a comparable focal length zoom lens.
- A prime lens is physically smaller and lighter in weight than a zoom lens featuring a comparable maximum focal length and aperture (f-ratio). The exception is ultra-fast prime lenses, which are comparatively heavy.

The maximum aperture (f-ratio) of most zoom lenses changes as focal length changes. At the shortest focal length, maximum aperture can be suitable for low-light photography but at the longest focal length, maximum aperture may be too small. The Canon EF 70-300mm f/4-5.6 IS USM telephoto zoom lens, for example, is one stop slower at maximum zoom than it is at minimum zoom.

Canon and Nikon offer some zoom lens models that feature a large (fast) *constant maximum aperture.* Maximum aperture remains constant throughout the focal length range. Some such lenses are suitable for manual clandestine photography, two examples being the Canon EF 70-200mm f/2.8L IS II USM and Nikon AF-S NIKKOR 200-400mm f/4G ED VR II telephoto zoom lenses. Visit the Canon or Nikon website and check for newer models before making a purchase. Both companies engage in continuous research and development and they respond to market forces. Both companies periodically introduce new lenses while discontinuing others.

Lenses for Crop-Sensor Cameras

> Each camera and lens manufacturer designates their "crop-sensor lenses" differently–Canon EF-S; Nikon DX; Pentax DA; Sony DT; Sigma DC; Tamron Di II; Tokina DX. The Nikon and Cannon system of crop-sensor lenses is not as comprehensive as their system of full-frame lenses is.

Most manufacturers of digital single-lens reflex (DSLR) cameras make full-frame and crop-sensor cameras. They also offer lenses that are compatible with both their full-frame and crop-sensor cameras, and they make lenses compatible only with crop-sensor cameras. Each manufacturer designates their crop-sensor lenses differently as indicated in the above epigraph.

Canon EF-S lenses intended for crop-sensor cameras do not work with full-frame cameras because the size of the image circle produced by the lens does not cover the entire image sensor. The result is a vignette image. Nikkor DX lenses intended for crop-sensor cameras also produce an image circle too small to cover a full-frame image sensor. Nevertheless, many full-frame Nikon DSLR cameras have an innovative feature that crops the image sensor when the camera sports a DX lens.

Manufacturing lenses specifically for crop-sensor cameras address the focal length conversion factor issue. Wide-angle lenses made for full-frame DSLR cameras are not as wide angle once placed on a crop-sensor camera and photographers found that troublesome. Angle-of-view and therefore field-of-view was inadequate. The focal length conversion factor situation usually is not a troublesome issue with telephoto lenses.

Many photographers using crop-sensor DSLR cameras purchase only lenses made for crop-sensor cameras. Other photographers use crop-sensor cameras but purchase only lenses made for full-frame cameras. Still other photographers using crop-sensor cameras use full-frame lenses but make an exception by purchasing one or two wide-angle lenses made for crop-sensor cameras. In the final analysis, the preferred lens system is a personal choice. Realize, however, if using a crop-sensor camera and purchasing only lenses made for crop-sensor cameras, the lenses will be incompatible with any full-frame DSLR camera purchased in the future. Some Nikon DSLR cameras, as stated, are an exception.

Image Stabilization/Vibration Reduction

Image stabilization technology enables surveillance specialists to record quality photographic images at slower-than-normal shutter speeds while handholding a camera and lens assembly. Image stabilization technology applies to single image cameras and camcorders.

Camera and lens manufacturers such as Canon and Nikon offer an assortment of lenses featuring image-stabilization technology. Previously stated, Canon calls it *Image Stabilization* (IS) while Nikon calls it *Vibration Reduction* (VR), each being a different but correct term for the same feature.

Image stabilization provides the clandestine photographer with four primary benefits. The four benefits are:

- Stabilization permits handholding the camera while using a slower-than-normal shutter speed.
- Stabilization permits handholding the camera at a lower ISO than otherwise would be necessary. A low ISO contributes to better image quality, increasing ISO introduces electronic noise, which diminishes image quality.
- While handholding the camera, stabilization permits using a smaller aperture for increased depth-of-field even though the ambient level of illumination is low.
- While handholding the camera, stabilization permits reducing aperture to the *critical aperture* of the lens even though the ambient level of illumination is low. Critical aperture is the f-stop that provides the best resolution. Many photographers refer to the critical aperture as the lens' sweet spot. Because with most lenses critical aperture is about two f-stops below maximum aperture, photographers stop down two f-stops when they need maximum resolution but critical aperture is

unknown. Surveillance specialists should do likewise when maximum resolution is essential.

The efficiency of the image-stabilizing feature varies from one camera and lens manufacturer to the next, and efficiency varies from one lens to the next within a camera system. Nevertheless, typically, the stabilizing feature provides a stabilization correction advantage of 3–4 stops. For handheld photography, the advantage of image stabilization is obvious (refer to Figure 4-48 in Chapter 4).

Optical image stabilization is preferred. Optical image stabilization technologies vary in operational detail although generally they are hardware based and operate by means of a built-in gyrosensor and microprocessor. The gyrosensor and microprocessor work together to neutralize the effects of camera and lens movement. Optical image stabilization is true image stabilization.

Depending on the camera model or specific lens in use, the surveillance specialist has various optical image stabilization modes from which to choose. The specialist may select continuous mode wherein the stabilizing function is on continuously. Alternatively, the shoot only mode activates the stabilizing feature when depressing the shutter release button to take a picture. In normal mode, the stabilizing feature corrects for camera movement in all directions. In the pan mode, the mode used when panning to follow a moving subject, the stabilizing feature corrects vibrations occurring only at right angles to the direction of panning.

The camcorder section discusses image stabilization as it pertains to camcorders and it addresses digital stabilization. Digital stabilization is not true image stabilization.

Auto-Focus Lenses

Most compact digital cameras, digital bridge cameras, and camcorders feature auto-focus (automatic focus). Similarly, most telephoto lenses made for digital single-lens reflex (DSLR) cameras feature auto-focus. Auto-focus is, as the name implies, a technology that focuses a lens automatically.

Some photographers find auto-focus useful if not essential. Sports photographers recording fast moving activity find auto-focus helpful and in some instances essential. Nevertheless, many surveillance specialists prefer to focus manually, and some need to. The specialist using a high-magnification telephoto lens should focus manually to achieve precise subject-specific focus. The specialist also focuses manually when the time required for an auto-focus lens to achieve focus lock may result in excessive shutter lag. In some

instances, unrelated things in the scene will capture auto focus, leaving the subject out of focus, which makes focusing manually necessary. Finally, some lighting conditions are too dark for auto-focus to work.

Ultra-Fast Telephoto Lenses

> Whether a lens is fast or slow depends on its maximum aperture relative to its focal length. In comparison to slower lenses of the same focal length, fast lenses are large, heavy, and expensive.

Lenses that feature a large maximum aperture (i.e., large diameter objective lens) relative to focal length are *fast* lenses. Clandestine photographers need fast lenses because they frequently photograph under low-light conditions. Lens systems that feature a small maximum aperture relative to focal length are *slow* lenses. The Canon 400mm f/2.8 telephoto lens is extremely fast while the Canon 400mm f/5.6 telephoto lens is slow. Although the f/2.8 maximum aperture makes the Canon 400mm telephoto lens extremely fast, a 60mm f/2.8 lens is slow. Indeed, whether a lens is fast or slow depends on its maximum aperture relative to its focal length.

A large aperture (fast) lens transmits more light than a small aperture (slow) lens of the same focal length does. For example, the Canon EF 200mm f/2L IS USM lens is one stop faster than the Canon EF 200mm f/2.8L II USM lens. The f/2 lens transmits one stop more light than the f/2.8 lens does.

Large aperture (fast) lenses are essential for low-light photography, but the large aperture results in a comparatively large and heavy lens (see Figure 2-14). Although lens speed is essential for low-light photography, the large aperture of fast lenses results in limited depth-of-field when used at maximum aperture. Limited depth-of-field leaves the lens unforgiving of even minor focusing errors. When using a fast lens at maximum aperture, perfect subject-specific focus is essential. Therefore, when circumstances permit, the surveillance specialist often focuses manually.

TELE-CONVERTERS

> There are no focal reducers for camera lenses, but there are Barlow lenses (negative projection lenses). They're called *teleconverters,* and–just like a Barlow lens in a telescope–they increase the focal length and the f-ratio, making the image larger and dimmer. (Covington, 2007, p. 57, *Digital SLR Astrophotography*)

Figure 2-14. An increase of one stop in lens speed results in a considerable size and weight increase. *Upper left image:* The Canon EF 200mm f/2.8L II USM telephoto lens weighs 765 grams (1.69 pounds). *Upper right image:* The Canon EF 200mm f/2L IS USM telephoto lens weighs 2,520 grams (5.56 pounds). *Lower left image:* The Canon 300mm f/4L IS USM telephoto lens weighs 1,190 grams (2.62 pounds). *Lower right image:* The Canon 300mm f/2.8L IS USM telephoto lens weighs 2,550 grams (5.62 pounds).

Conventional Use of Tele-Converters

Tele-converters are small lightweight secondary optical devices that photographers place between a telephoto lens and digital single-lens reflex (DSLR) camera to increase the effective focal length of the lens (see Figure 2-15). Tele-converters increase effective focal length by optically enlarging the central area of the image produced by the host lens. Although Canon and Nikon tele-converters are compatible with several zoom lenses, tele-converters perform best with fixed focal length (prime) lenses.

Tele-converters are the subject of controversy among photographers; some like them and some do not. In spite of the arguments against the use of tele-converters (e.g., reduced image resolution, diminished f-ratio, and slow-

Figure 2-15. Tele-converters are secondary optical devices that magnify the central area of the image created by the host lens. Illustrated is the Canon EF 200mm f/2L IS USM telephoto lens, Canon EF 2x II tele-converter, and Canon EOS 5D Mark II digital single-lens reflex camera. *Upper image:* Camera and lens without a tele-converter. *Center image:* Camera, lens, and tele-converter assembled and ready for use. *Lower image:* Exploded view of the lens, tele-converter, and camera.

er auto-focus), they serve a useful purpose for manual clandestine photography. In some instances, tele-converter use is essential.

Tele-converters provide greater magnification with little increase in lens size and weight. Minimizing size and weight is necessary in many instances such as when backpacking equipment to a remote rural vantage point. A tele-converter is also useful when discreteness requires using a smaller lens; a 300mm lens with a 2x tele-converter is physically much smaller than a 600mm prime lens. In other instances, extreme camera-to-subject distance

requires using a tele-converter to increase the effective focal length of the strongest telephoto lens available. For example, the surveillance specialist with a Canon or Nikon 600mm lens may need a 1200mm lens for the distance involved and, for that reason, uses the 600mm lens with a 2x tele-converter.

Manufacturers refer to tele-converters by several different names. Canon calls them an *extender, lens extender,* and *tele extender*. Nikon calls them a *tele-converter*. Sony calls them a *teleconverter* and *tele-converter* but on the product itself is printed the name *TELE CONVERTER*. Photographers commonly call them a *tele-converter, extender, multiplier,* or *converter,* and they commonly call the 2x tele-converter a doubler. The various names are synonymous and correct but for purposes of consistency, the author's use the term tele-converter, in most instances.

The clandestine photographer's ability to photograph from increased distances by using tele-converters provides four primary benefits. The four benefits are:

- Increased camera-to-subject distance reduces the likelihood of detection by the subject. Distance provides cover.
- Increased camera-to-subject distance means having more vantage point options.
- An enhanced telephoto capability increases the likelihood of locating a higher elevation vantage point to avoid photographing through near ground thermals. Although the high elevation vantage point may be farther from the subject location than a low-level vantage point, avoiding near ground thermals makes it possible to photograph from a considerably greater distance (refer to Figure 7-1 in Chapter 7, that illustration dramatically showing the importance of an elevated vantage point when photographing from long distances).
- In the event that somebody near the photography team discovers that photography is occurring, the great camera-to-subject distance often leaves the person unable to determine what or whom the surveillance specialist is photographing. Additionally, use of a suitable pretext can leave people in the photography team's vicinity unaware that what they see is a clandestine operation. A suitable pretext is useful in many instances.

Tele-converters increase the size of the image circle provided by the host lens and thereby they increase the *effective* focal length of the lens (see Figure 2-16). The most common magnifying powers of tele-converters for digital

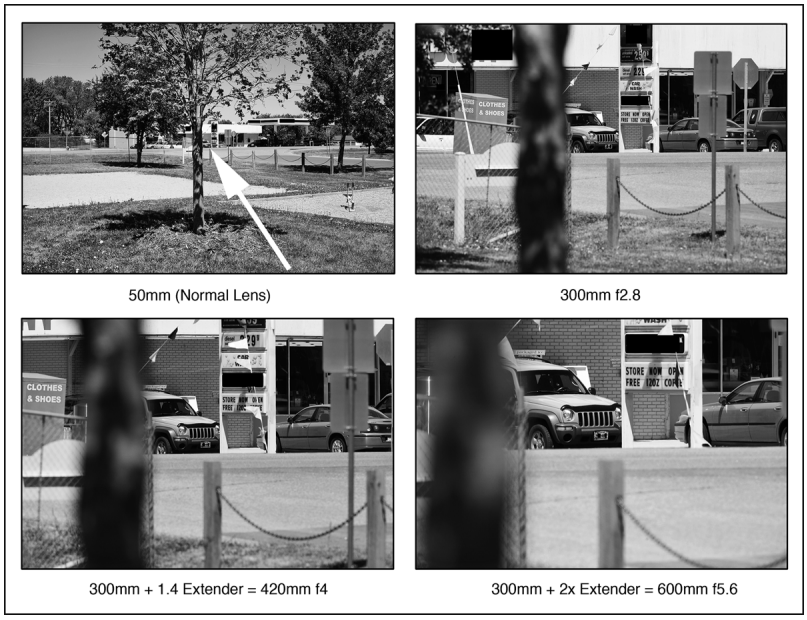

Figure 2-16. Tele-converters enlarge the central area of the image circle created by the host lens and thereby they increase the *effective* focal length of the lens. Images recorded from 115.21 meters (126 yards).

single-lens reflex cameras is 1.4x, 1.7x, and 2x. Canon provides a 1.4x and a 2x auto-focus tele-converter. Nikon provides a 1.4x, 1.7x, and a 2x auto-focus tele-converter.

Auto-focus tele-converters feature electrical contacts and an electrical harness that permits the camera and lens to communicate electronically even though physically separated by the tele-converter. Near the conclusion of this writing, Canon introduced the Extender EF 1.4x III and Extender EF 2x III. Canon, at their website, reports that these newest tele-converters feature "a built-in microcomputer for seamless communication among camera body, lens and extender."

Tele-converters increase the magnification of prime lenses and zoom lenses but they decrease resolution and effective aperture by the same amount that they increase magnification. That occurs because tele-converters simply enlarge the central area of the image circle created by the host lens. Nevertheless, results are reasonably good. Results are better than an image recorded without a tele-converter and then cropped and enlarged to the size the tele-converter would have provided.

Tele-converters decrease image resolution and contrast for a couple of reasons. First, the tele-converter magnifies the central area of the lens's image circle and that diminishes resolution. A tele-converter decreases resolution

by an amount equal to the degree of magnification increase, resolution diminishing even though the tele-converter magnifies the best portion of the image, the central area. Second, image quality diminishes somewhat because light passes through more glass before reaching the camera's image sensor; tele-converters contain several lens elements. For example, the Canon EF 2x III tele-converter features nine lens elements in five groups. The situation is likewise with Nikon tele-converters. The result of magnifying the image and requiring light to pass through more glass (lens elements) diminishes resolution and contrast.

In spite of their shortcomings, tele-converters have merit, especially for clandestine photography. Nevertheless, a lens and tele-converter combination cannot provide image quality comparable to the image provided by a prime lens of comparable focal length. For example, a 300mm lens used with a 2x tele-converter cannot provide image quality comparable to the image provided by a 600mm prime lens (see Figure 2-17).

When using a tele-converter, the effective focal length of the lens increases by an amount equal to the magnification factor of the tele-converter. However, previously stated, light transmission decreases by the same amount. The result of decreased light transmission is a reduction of *effective* maximum aperture and that creates the need to select a larger aperture, a slower shutter speed, a higher ISO or a combination thereof. When photographing under low-light conditions the lens is already at maximum aperture so increasing ISO or using a slower shutter speed, or both, is necessary. Decreased light transmission also results in a dimmer viewfinder image, which sometimes makes manual focusing difficult.

Because tele-converters decrease light transmission, they perform well for daytime photography but their use for nighttime photography is limited to areas featuring sufficient artificial illumination. Nighttime areas featuring artificial illumination do require using a high ISO and slow shutter speed but results tend to be satisfactory for investigative, intelligence collection, and tactical purposes (see Figures 2-18 and 2-19).

Tele-converters provided by Canon work with some but not all Canon lenses. Similarly, tele-converters provided by Nikon work with some but not all Nikkor lenses. The technical information provided by each manufacturer specifies which lenses are compatible with each tele-converter. Moreover, the technical information identifies which lenses retain their auto-focus capability when used with a tele-converter. When used with a tele-converter, some lenses retain their auto-focus feature but at a reduced speed, and some become manual focus lenses.

When using tele-converters, same brand products provide best results. For example, use Canon tele-converters with Canon lenses and use Nikon

Figure 2-17. A lens and tele-converter combination cannot provide image quality comparable to the image provided by a prime lens of comparable focal length. These images recorded from 115.21 meters (126 yards). *Upper image:* Image recorded using the Canon EF 300mm f/2.8L IS USM telephoto lens with the Canon EF 2x II tele-converter. The *effective* focal length and f-ratio (aperture) is 600mm f/5.6. *Lower image:* Image recorded using the Canon EF 600mm f/4L IS USM telephoto prime lens. Scrutinize the comparative image quality of the greatly enlarged insets of the vehicle number plate.

tele-converters with Nikkor lenses. Canon and Nikon optimize their tele-converters for specific lenses within their respective lens systems; one need fear no optical, mechanical, or electronic incompatibility. Remember that modern DSLR cameras are sophisticated computers and the lenses contain a

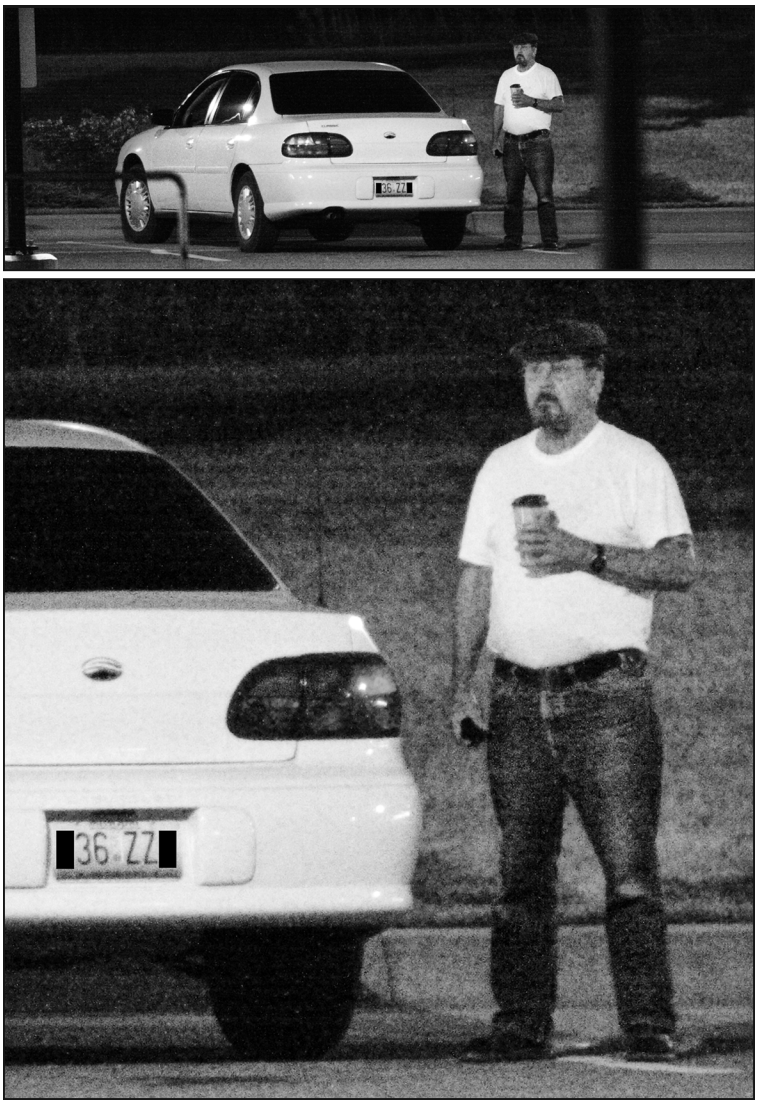

Figure 2-18. Nighttime high ISO available light photograph recorded from 306.32 meters (335 yards). Illumination provided by parking lot lights. Tele-converter use at night is possible when sufficient artificial illumination exists and when used with a DSLR camera featuring a sufficiently high ISO capability. *Upper image:* Image cropped top and bottom only, sides not cropped. *Lower image:* Cropped portion of the upper image. Subject photographed using the Canon EF 600mm f/4L IS USM telephoto lens with the Canon EF 2x II tele-converter and Canon EOS 30D crop-sensor digital single-lens reflex camera. *Effective focal length and f-ratio (aperture):* 1200mm f/8. *ISO:* 3200. *Exposure time:* 1/6th second. A DSLR camera featuring a higher maximum ISO would have permitted using a faster shutter speed. *To compensate for slow shutter speed, record numerous sequential images so that the subject is movement free in some of the images—people usually are not in constant motion.* The next illustration shows the camera and subject locations.

Figure 2-19. In the upper image, the arrow points to the subject and vehicle appearing in the previous illustration, that image recorded using a "normal" focal length lens from the location of the telephoto lens. In the lower image, the line identifies the camera and subject locations.

computer chip. The camera tells the lens what aperture to assume, and the camera participates in the auto-focus and image stabilizing process.

When using a tele-converter, determine the *effective* focal length and aperture of the host lens and tele-converter combination by multiplying the focal length and maximum aperture of the host lens by the magnification rating of the tele-converter. For example, a 300mm f/4 telephoto lens with a 2x teleconverter features an effective focal length and f-ratio (aperture) of 600mm f/8.

A 1.4x tele-converter causes a one stop loss of light. Nikon reports that their 1.7x tele-converter causes a 1.5 stop loss of light. Finally, a 2x tele-converter causes a 2 stop loss of light.

Tele-Converter Modification for Telescopes

Refracting telescopes and Schmidt-Cassegrain telescopes accept manual photographic tele-converters. Making a manual tele-converter from an auto-focus tele-converter is not difficult.

Canon and Nikon auto-focus tele-converters work with specified lenses within the respective systems. The tele-converters, as stated, contain electrical contacts and an electrical harness that permits the camera and lens to communicate. Also stated, the latest generation of Canon tele-converters features a built-in microcomputer that facilitates communication between the camera, lens, and tele-converter.

When placing an auto-focus tele-converter onto a refracting telescope or a Schmidt-Cassegrain telescope, the camera does not recognize the telescopes. The camera tries unsuccessfully to communicate with the telescope as if it were a dedicated telephoto lens. Failing in that attempt, the camera ceases to function and sends a message to the LCD monitor advising that the electrical contacts are dirty.

Removal of the electronic system (i.e., electrical contacts and harness) from an auto-focus tele-converter makes it a manual tele-converter. As a manual tele-converter, it will work with refracting telescopes and with Schmidt-Cassegrain telescopes (see Figures 2-20 and 2-21). Some photographers place thin tape on the electrical contacts of auto-focus tele-converters so that the camera attempts no electronic communication with the lens.

Removing the electrical components from the Canon tele-converter was easy inasmuch as the tele-converter reassembled the same way it disassembled, only in reverse. The lens elements were contained in a secondary housing and remained together as a unit during disassembly. Modifying a tele-converter voids the warranty so consider purchasing a used tele-converter for modification. Check the used inventory of B & H Foto & Electronics Corporation and Adorama. Previously stated, some photographers simply place thin tape on the electrical contacts to avoid "ruining" the tele-converter.

Tele-converters work well with SCTs to increase magnification as the previous illustration attests. A secondary benefit when using a tele-converter with an SCT is exclusion of the somewhat out-of-focus perimeter area of the image resulting from the field curvature that characterizes SCTs. Field curvature, also called curvature of field, is an occurrence whereby focus is different between the center and peripheral areas of the film plane. The tele-converter magnifies the central area of the image circle, which is the best part of the image. By excluding the poorly focused perimeter of the image circle, the result is an image featuring reasonably good edge-of-field clarity.

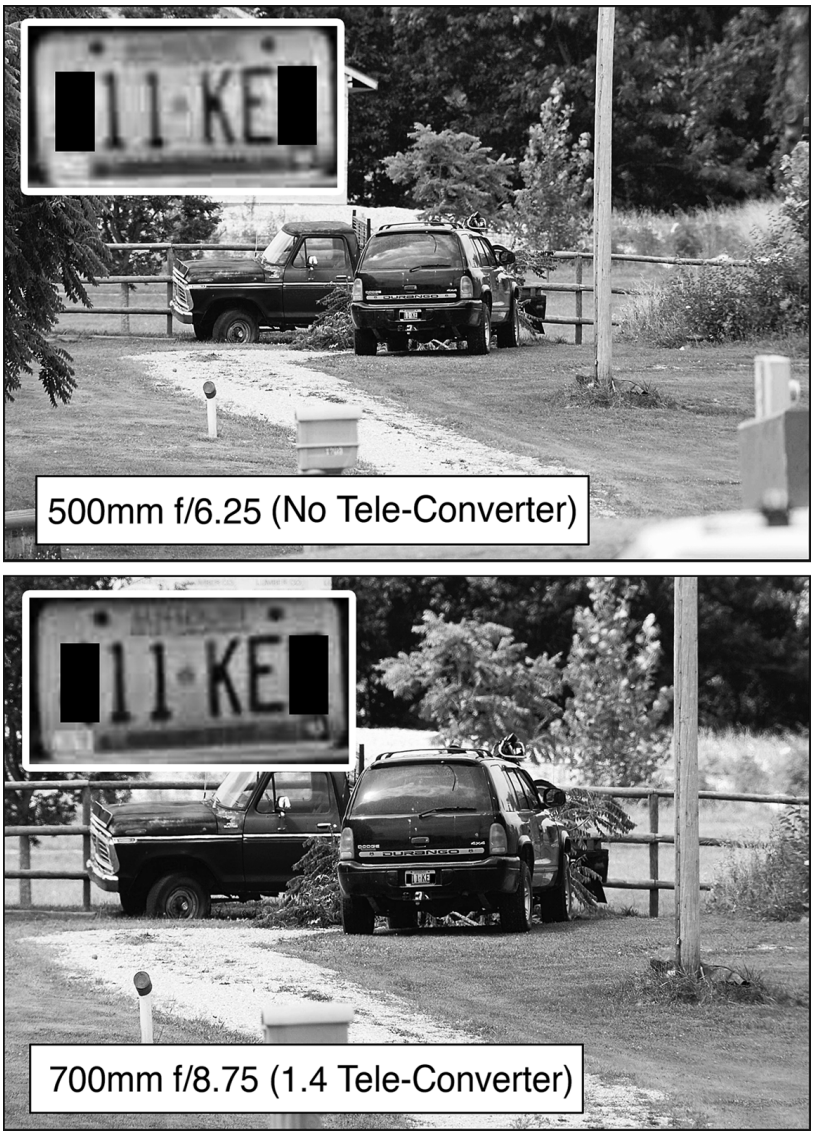

Figure 2-20. *Camera-to-subject distance:* 251.46 meters (275 yards). The 500mm f/6.25 Celestron Onyx 80 EDF refracting telescope performs well when used as a telephoto lens by means of the prime-focus (direct coupling) method. Moreover, the telescope works well with auto-focus tele-converters after making them a "manual" tele-converter by removing the electrical harness and electrical contacts. *Upper image:* Image recorded using the telescope without a tele-converter. *Lower image:* Image recorded using the telescope with a Canon 1.4x tele-converter resulting in an effective focal length and f-ratio of 700mm f/8.75. *Note:* An elevated camera position would have resulted in better image quality by minimizing the effects of near ground thermals. Images recorded on a clear day.

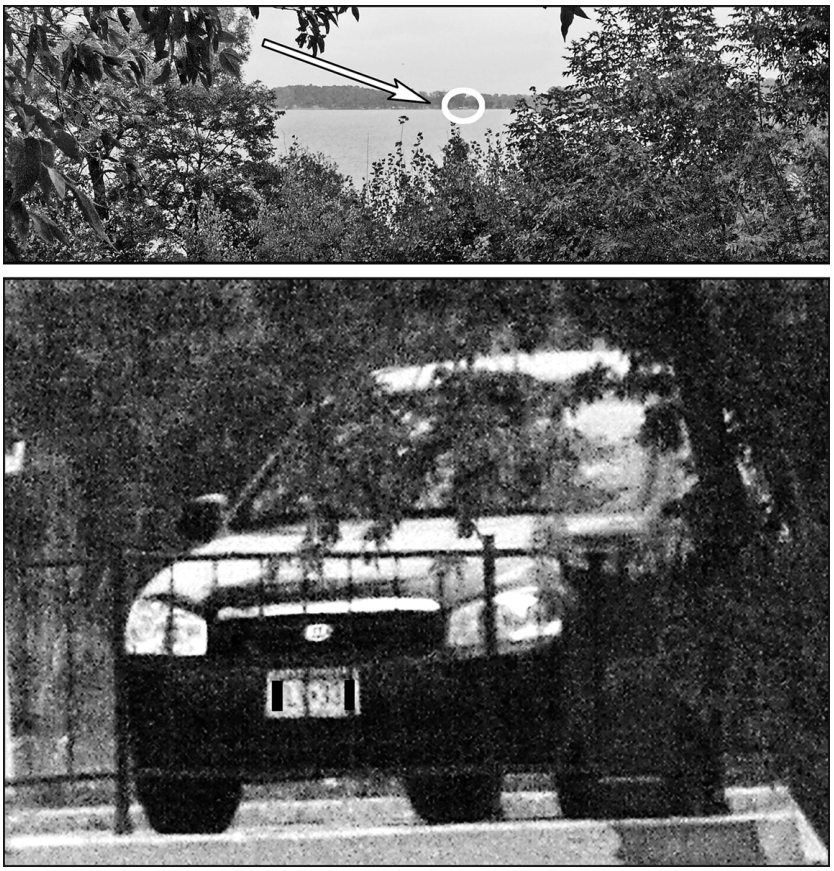

Figure 2-21. Extreme distance photography is possible using a Canon or Nikon tele-converter with a high-magnification Schmidt-Cassegrain telescope (SCT). *Upper overview image* cropped top and bottom only, the white circle identifying the subject location. The *lower image* is a cropped portion of an image recorded from 1.79 kilometers (1.11 miles) using the Canon EOS 30D digital single-lens reflex (DSLR) crop-sensor camera with the 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). Between the telescope and camera was a Canon 1.4x tele-converter resulting in an effective focal length and f-ratio of 4267mm f/14–magnification 85x. Removal of the electronic system (i.e., electrical contacts and harness) from the auto-focus tele-converter made it a manual tele-converter. As a manual tele-converter, it is compatible with refracting telescopes and, as illustrated here, high-magnification Schmidt-Cassegrain telescopes (SCTs). *Atmospheric conditions:* Poor. Within 20 minutes of recording this image, heavy rain began and the National Weather Service issued tornado warnings for the immediate area. The upper image reveals how dense the atmosphere was at the time of photographing. *Supplemental techniques:* A focusing cloth draped over the surveillance specialists head resulted in a brighter viewfinder image and an eyepiece magnifier (rectangular angle finder) aided precise focusing. *ISO:* 800. *Exposure time:* 1/250 second. The angle-of-view of this telescope when used with a 1.4x tele-converter and crop-sensor DSLR camera featuring a 1.6x focal length conversion factor is only about 0° 18'.

SCHMIDT-CASSEGRAIN TELESCOPE

> Telescopes are rated for their aperture; camera lenses, for their focal length. (Covington, 2007, p. 56, *Digital SLR Astrophotography*)

> When researching telescopes one will encounter the term "optical tube assembly" (OTA). An OTA is a telescope without an equatorial mount and tripod assembly–it is just the telescope. An OTA can be a refracting or Catadioptric optical system.

Introduction

Schmidt-Cassegrain telescopes (SCTs) provide the surveillance specialist with an ultra high-magnification telephoto photography/videography capability. Additionally, SCTs offer a low-cost way to acquire a high-magnification telephoto capability. For example, at the time of this writing the Canon EF 800mm f/5.6L IS USM super telephoto lens retails for approximately $12,349 (USD). For about 1/20th the cost, the specialist can obtain an SCT featuring comparable magnification and f-ratio. The 1250mm f/10 Celestron C5 Schmidt-Cassegrain spotter, when used with an f/6.3 focal-reducer, is 787.5mm f/6.3, that being just 12.5mm less focal length and only 1/3 stop slower than the 800mm f/5.6 Canon lens. The C5 retails for only about $430 (USD); total cost about $580 with a T-Adapter, T-Ring, and f/6.3 focal-reducer. Optically it cannot compete with the Canon lens, but performance is acceptable.

In the United States, Celestron® and Meade® Instruments Corporation are the two premier manufacturers and retailers of telescopes and telescope accessories. Both companies do their own research and development and they manufacture their high-end Schmidt-Cassegrain telescopes (SCT) in the United States. Moreover, both companies demonstrate a commitment to product quality and customer service. For good reason, these two companies dominate the telescope market. Both companies provide high quality refracting telescopes and Schmidt-Cassegrain telescopes, many of the telescopes being suitable for long-range and ultra-long-range manual clandestine photography.

For optimum light collection, Catadioptric telescopes manufactured by Meade Instruments Corporation feature oversized primary mirrors, the diameter of the mirrors being larger than the listed aperture of the telescope. For example, the 8-inch (20.3 cm) LX90ACF and LX200-ACF telescopes feature a primary mirror measuring 8.25-inches (21 cm) in diameter.

In the epigraph and previous paragraph the term "Catadioptric" appeared. Schmidt-Cassegrain telescopes (SCTs) are a Catadioptric optical

system. Wikimedia defines a Catadioptric lens explaining that, "A catadioptric optical system is one where refraction and reflection are combined in an optical system, usually via lenses (dioptrics) and curved mirrors (catoptrics)" (Catadioptric system, *Wikimedia Foundation, Inc.,* 2010, June 15, n.p.). Celestron, one of the premier manufacturers of high quality Schmidt-Cassegrain telescopes describes a Catadioptric as follows:

> The Schmidt-Cassegrain is a telescope that uses a combination of mirrors and lenses (catadioptric optics) to fold the optics and form an image. The light enters through a thin aspheric Schmidt correcting lens, then strikes the spherical primary mirror and is reflected back up the tube and intercepted by a small convex spherical secondary mirror which reflects the light out an opening in the rear of the instrument where the image is formed at the eyepiece. (Celestron.com, 2008, n.p., *Schmidt-Cassegrain telescopes*)

Astronomers and surveillance specialists commonly refer to a Schmidt-Cassegrain telescope as a Cat lens. Cat is a shortened form of Catadioptric. The Schmidt-Cassegrain telescope is a Catadioptric optical system because it features a refracting lens and reflective surfaces (mirrors) working together to minimize optical aberrations and to shorten the physical length of the telescope.

In his book *Digital SLR Astrophotography,* Michael Covington (2007, p. 56) explains that, "Telescopes in the Cassegrain family have a focal length longer than the actual tube length because the secondary mirror enlarges the image." Characterizing the Schmidt-Cassegrain design is a refracting corrector plate (lens) at the front of the tube to minimize spherical aberration, a primary mirror at the back of the tube, and a secondary mirror at the front of the tube. This optical design results in a folded optical path that provides a long focal length in a short tube (see Figure 2-22 and refer ahead to Figure 2-24). The compactness of Schmidt-Cassegrain telescopes is one of the features that make them so desirable for clandestine applications–high magnification in a small package.

Mounting a DSLR camera to a Schmidt-Cassegrain telescope for prime-focus (direct coupling) photography requires using a T-Adapter and a T-Ring. The mounting procedure is as follows:

- Thread the T-Ring onto the T-Adapter.
- Mount the camera to the T-Ring.
- Thread the T-Adapter to the telescope while holding the camera in position (refer to the previous illustration and refer ahead to Figure 2-24).

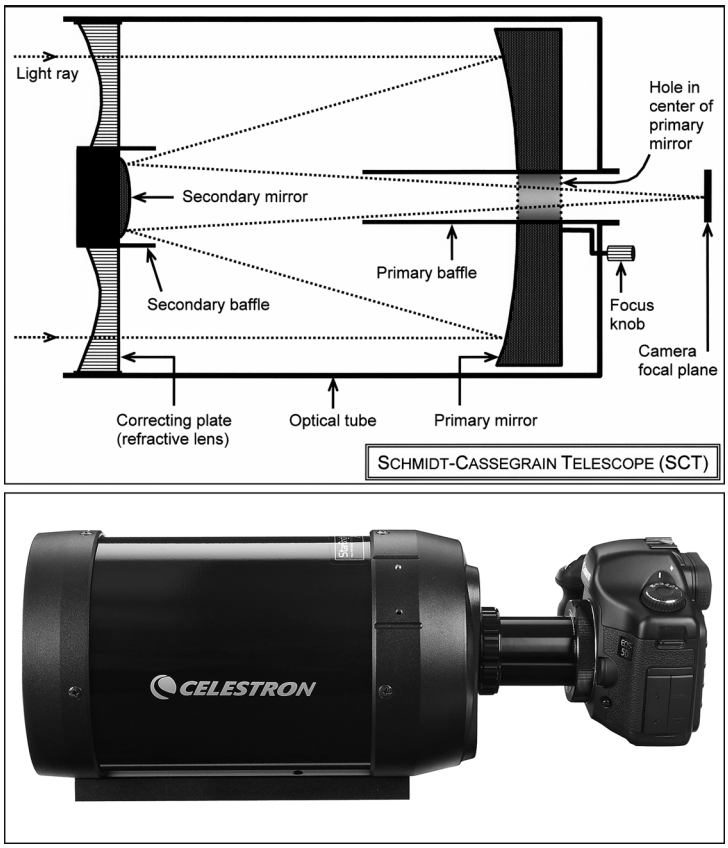

Figure 2-22. The folded light path and the design of the correcting plate (refracting lens) and two mirrors in a Schmidt-Cassegrain telescope result in a long focal length but short physical length. Optically, the 1250mm f/10 Celestron C5, pictured here, is 1250 millimeters (49.21 inches) long but physically it measures only 330.20 millimeters (13 inches). The compactness of Schmidt-Cassegrain telescopes is one of the features that makes them so desirable for clandestine applications–high magnification in a small package. The Celestron C5 is an *optical tube assembly* (OTA) because Celestron sells it without an equatorial mount and tripod assembly.

Schmidt-Cassegrain telescopes (SCTs) feature a wide range of focal lengths. For example, Celestron SCTs feature a focal length range of 1,250 millimeters to 3,910 millimeters. The Meade LX90 series SCTs feature a focal length range of 2,034 millimeters to 3,048 millimeters. The Meade LX200 series telescopes feature a focal length range of 2,000 millimeters to 4,064 millimeters.

Schmidt-Cassegrain telescopes (SCTs) are useful for extreme distance manual clandestine photography during daylight hours, and at night using an

image intensifier night vision device (NVD). SCTs are useful for ultra-long-range photography for the following reasons:

- "Best all-around, all-purpose telescope design. Combines the optical advantages of both lenses and mirrors while canceling their disadvantages" (Celestron.com, 2008, n.p., *Schmidt-Cassegrain telescopes*).
- SCTs are reasonably economical because their design is well suited to mass production.
- SCTs provide good image quality although not comparable to an equivalent focal length refracting lens. Realize, however, that no refracting lenses exist with focal lengths comparable to the focal length of SCTs.
- SCTs are versatile and portable.
- SCTs are easily adaptable to photography.
- SCTs feature considerable range of back focus, which makes prime-focus (direct coupling) photography easy and effective.
- SCTs accept a wide range of accessories.
- When used for prime-focus (direct coupling) photography SCTs provide an image that covers a 36 x 24 millimeter (full-frame) DSLR camera image sensor, although slight vignetting at the corners does appear (see Figure 2-23).

Collimation

During transit, setup, and takedown, Schmidt-Cassegrain telescopes (SCTs) suffer vibrations and mini impacts that can result in collimation requiring periodic correction. Michael Covington confirms the importance of knowing how to collimate SCTs. In his book *Astrophotography for the Amateur,* he explains that "Most Schmidt-Cassegrains in use by amateurs are substantially out of collimation most of the time; learn to make this simple adjustment and you can greatly improve your telescope" (Covington, 1999, p. 72). Once properly collimated, treat the SCT as a precision and fragile optical instrument, treating it as delicately as field use permits. Nevertheless, field conditions are harsh and knowing how to collimate SCTs will ensure peak performance and quality photographic images.

Field Curvature

> Field curvature is "An inability to bring the center and edge of the field into focus at the same time, with the edge out of focus when the center is sharply focused and vice-versa." (Astronomics, 2009, n.p., *Field curvature*)

Figure 2-23. *Camera-to-subject distance:* 0.805 kilometer (0.5 mile). The upper image is a cropped portion of the lower image. Prime-focus (direct coupling) photography using a full-frame digital single-lens reflex (DSLR) camera with a Schmidt-Cassegrain telescope (SCT) commonly results in vignetting at the corners of the frame. Vignetting is normal with SCTs because their design anticipates use with telescope eyepieces not full-frame DSLR cameras. No vignetting occurs when using a crop-sensor DSLR camera with an SCT because the smaller image sensor is well within the image circle. *Method:* Prime-focus (direct coupling) using mirror lock-up and a remote shutter release. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens/telescope:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope. *ISO:* 320. *F-Ratio (aperture):* f/10. *Exposure time:* 1/320 second. *Atmosphere:* Good.

Like most telescopes, Schmidt-Cassegrain telescopes (SCTs) feature field curvature with the curvature measured in terms of radius of curvature. The central area of the image is best and for that reason, placing important subject matter in the central area of the frame produces the best photographic images. Important subject matter includes, but is not limited to, a subject's face and vehicle number plates.

Because the f/6.3 focal-reducer is also a field-flattener, consider using a longer focal length SCT than is otherwise necessary and then flatten the curved field using an f/6.3 focal-reducer. Additionally, when field-of-view is sufficient to permit it, use a crop-sensor DSLR camera because the smaller image sensor records only the central area of the image circle produced by the telescope. When recording a smaller area of the image circle, the focus discrepancy between the center and edges of the photographic image is less.

Increasing Focal Ratio and Image Brightness

> The focal ratio is "the 'speed' of a telescope's optics, found by dividing the focal length by the aperture. The smaller the f/number, the lower the magnification, the wider the field, and the brighter the image with any given eyepiece or camera." (Aquila Optical & Electronics, n.p., n.d. *Focal Ratio*)

When circumstances require making a Schmidt-Cassegrain telescope (SCT) faster for prime-focus photography, use an f/6.3 focal-reducer to increase the effective focal ratio (f-ratio) by 1 1/3 stops. That, of course, reduces magnification by 37 percent. Retaining essential magnification may require using an SCT of greater focal length than otherwise required so that the reduced magnification caused by the focal-reducer is suitable for the camera-to-subject distance. This method, using a larger SCT, provides a secondary benefit and that is the fact that large SCTs provide a better and brighter image than small SCTs do. John Torae explains this as follows:

> Frequently, there is a false impression that the surface brightness of an astronomical object is determined by the focal ratio of the telescope. In reality, the surface brightness is determined by the light grasp of a telescope, which is a function of the area of the aperture of the telescope. (Torae, John, n.d., n.p., *Focal Length and Focal Ratio*)

What John Torae says can be illustrated by comparing two Schmidt-Cassegrain telescopes (SCTs); 1500mm f/10 6-inch (152.4 mm) Celestron C6 SCT and the 2800mm f/10 11-inch (279.4 mm) Celestron C11 SCT. Although both SCTs are f/10, the C11 will provide a brighter and higher quality image than the C6 will, aside from their difference in magnification.

During daytime afocal photography, using a telescope eyepiece of greater focal length than the focal length of the camera lens will increase the effective f-ratio (speed). During nighttime afocal photography using an image intensifier night vision device (NVD), and using a telescope eyepiece of greater focal length than the objective lens of the NVD will increase effective f-ratio. When necessary, during afocal photography during the day or at

night using a night vision device, make a further f-ratio increase by using a long focal length telescope eyepiece with the f/6.3 focal-reducer.

Chapter 4, *Techniques and Methods of Manual Clandestine Photography,* and Chapter 5, *Night Vision Photography for Clandestine Operations,* discuss and illustrate the application of Schmidt-Cassegrain telescopes for manual clandestine photography.

F/6.3 Focal-Reducer Corrector Lens

> The f/6.3 focal-reducer increases the effective f-ratio of a Schmidt-Cassegrain telescope by making the image smaller and brighter. "The Celestron f/6.3 focal reducer threads onto the rear cell of any Celestron or Meade Schmidt-Cassegrain telescope. The exit side has a male thread matching that of the rear cell of the SCT, therefore, any existing accessories will simply thread onto this device. . . . The f/6.3 focal reducer compresses the light cone exiting the telescope to 63% of its original size. This effectively increases the field of view as seen by a CCD camera, and also serves to shorten exposure times" (Skies Unlimited, 2010, n.p., *Celestron f/6.3 Focal Reducer*).

Up to this point, text frequently referred to the f/6.3 focal-reducer. This section clarifies what the f/6.3 focal-reducer is and why it is so essential for any clandestine photographer using Schmidt-Cassegrain telescopes (SCTs). All surveillance specialists using SCTs should consider the f/6.3 focal-reducer an essential accessory.

For clandestine photography, SCTs are an inexpensive way to acquire high magnification and they are the only way to acquire extreme magnification. Surveillance specialists using SCTs for photography should have an f/6.3 focal-reducer to reduce magnification when necessary, and to increase effective f-ratio when necessary. The f/6.3 focal-reducer increases the effective f-ratio of a Schmidt-Cassegrain telescope (SCT) by making the image smaller and brighter.

The f/6.3 focal-reducer works with all SCTs regardless of size or manufacturer. As reported in the above epigraph, the focal-reducer threads onto the rear cell of any SCT with other accessories in turn threading to the focal-reducer as they would normally thread to the SCT.

A number of terms refer to this essential accessory product, terms such as but not limited to *F/6.3 Focal Reducer Corrector Lens, F/6.3 Focal-Reducer Field-Flattener,* and *f/6.3 reducer/corector.* Most users simply call it an *f/6.3 focal-reducer, focal-reducer,* or *reducer,* these latter three terms used in this book.

Designed for direct viewing and photography using Schmidt-Cassegrain telescopes, this remarkable product provides the surveillance specialist the means to accomplish the following.

- Increase effective f-ratio–make the SCT faster by an amount equal to 1 1/3 stops. The focal-reducer increases the effective f-ratio of a SCT by making the image smaller and brighter. The reducer increases the effective f-ratio of an SCT from f/10 to f/6.3 (from f/11 to f/7 in the case of the 3910mm f/11 Celestron C14 SCT). Although increasing effective f-ratio, it reduces magnification by 37 percent.
- Reduce magnification–decrease effective focal length by 37 percent.
- Increase field-of-view by 63 percent.
- Minimize the field curvature characterizing Schmidt-Cassegrain telescopes and thus improve edge-of-field clarity.

The f/6.3 focal-reducer placed between the T-Adapter and Schmidt-Cassegrain telescope (SCT) is often essential when photographing under low-light conditions with and without an image intensifier night-vision device (see Figure 2-24 and refer to Figure 5-23 in Chapter 5, upper and lower images). The focal-reducer decreases the size of the light cone, which reduces the size of the image circle thus increasing the brightness of the image (see Figure 2-25). Reducing the size of the image circle and thereby increasing the brightness of the image has the effect of increasing the effective f-ratio (aperture) of the telescope. Reducing the size of the image circle also increases field-of-view by including more of the image on the camera's image sensor. Nevertheless, increased field-of-view cannot exceed the SCTs angle-of-view. The Celestron and Meade focal-reducers are high quality 4-element optical devices. The Celestron focal-reducer is fully multicoated, while the Meade focal-reducer, according to information on the Meade website, is multicoated. Fully multicoated optics are preferred over multicoated.

Previously stated, the f/6.3 focal-reducer decreases magnification, increases effective f-ratio (aperture), increases field-of-view, and flattens the field which results in better edge-of-field clarity (see Figures 2-26 and 2-27).

Schmidt-Cassegrain telescopes (SCTs) produce an image featuring some degree of field curvature, previously stated. The f/6.3 focal-reducer is a 4-element convex lens system that minimizes field curvature and thereby improves edge-of-field correction, which results in higher quality photographic images. A benefit when using a crop-sensor DSLR camera with an SCT is recording only the central area of the image circle and thereby not recording the worst part of the image, which is the perimeter area. Using a crop-sensor DSLR camera and focal-reducer together tends to result in good image quality.

SCTs are fast when considering their f-ratio relative to focal length, but the f/6.3 focal-reducer makes them even faster. For example, the 3910mm f/11 Celestron C14 SCT becomes 2463mm f/7 when used with a focal-reducer. The 3048mm f/10 12″ Meade LX90-ACF telescope becomes 1920mm

Figure 2-24. The f/6.3 focal-reducer decreases the effective focal length and increases the effective f-ratio of Schmidt-Cassegrain telescopes (SCTs). Shown here is the 1250mm f/10 Celestron Schmidt-Cassegrain C5 Spotting Scope that the f/6.3 focal-reducer transforms into a 788mm f/6.3 optical system. The f/6.3 focal-reducer works in the manner illustrated here with all SCTs regardless of size and manufacturer. The exit side of a focal-reducer features male threads matching the threads of the rear cell of the SCT. In the absence of a focal-reducer, the T-Adapter screws directly to the SCT (refer back to Figure 2-22). In addition to decreasing magnification and increasing f-ratio, the focal-reducer flattens the curvature of field characterizing SCTs, which improves edge-of-field clarity.

f/6.3 when used with a focal-reducer. An effective f-ratio (aperture) of f/6.3 is extremely fast for such great focal lengths.

Increasing the effective f-ratio (aperture) of an f/10 Schmidt-Cassegrain telescope (SCT) to f/6.3 and increasing the DSLR camera ISO provides a significantly enhanced ultra-long-range low-light photographic capability. This is true for the recording of still images and for the recording of moving video images using the high-definition video mode of a DSLR camera. The focal-reducer also works when using camcorders with an SCT by means of afocal coupling.

For additional information on focal-reducer and tele-converter use, and the feasibility of using them together, refer to the subheading *Manipulating Magnification and F-Ratio: Four Schmidt-Cassegrain Telescopes in One* at the end of Chapter 4.

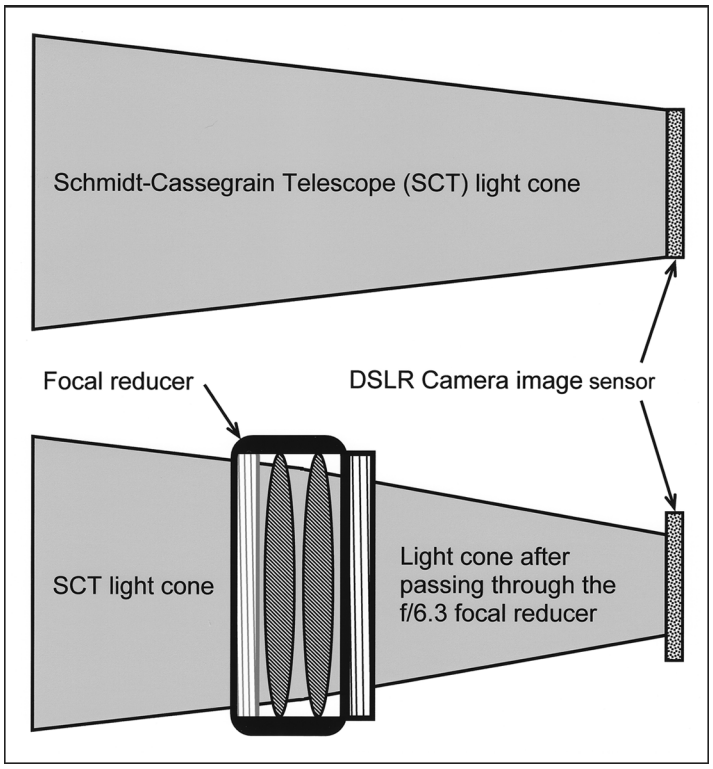

Figure 2-25. Focal-reducers decrease the diameter of the light cone, which increases the brightness of the image thus increasing the effective f-ratio (aperture).

F/6.3 Focal-Reducer and Flat Field Catadioptric Telescopes

Schmidt-Cassegrain telescopes (SCTs) feature field curvature, which reduces edge-of-field clarity. Nevertheless, when used for photography SCTs perform well. Unlike traditional SCTs, Celestron EdgeHD Schmidt telescopes and Meade LX200-ACF Series telescopes provide a flat focal plane all the way to the edge of the field of view. For that reason, Celestron and Meade advise against using an f/6.3 focal-reducer with their flat field lenses. The focal-reducer will cause the flat field to become a curved field.

The Skies Unlimited article (2001, n.p.) titled *Focal Reducers* explains that "focal reducers cannot be used with telescopes designed to produce a flat field because they will actually introduce an optical aberration. Standard focal reducers should not be used with the Celestron EdgeHD optical system." For the same reason, focal-reducers are incompatible with the Meade LX200-ACF series telescopes.

Figure 2-26. These images recorded from a distance of 0.97 kilometer (0.60 mile) using the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT). *Upper image:* Image recorded using the Celestron f/6.3 focal-reducer resulting in an effective focal length and f-ratio (aperture) of 1480mm f/6.3. *Lower image:* Image recorded without a focal-reducer, focal length and f-ratio (aperture) 2350mm f/10. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Method:* Prime-focus (refer to Figure 5-24 in Chapter 5 and Figures 4-63 and 4-64 in Chapter 4 to view comparative images).

The question begging an answer is whether the f/6.3 focal-reducer curves the field of a flat field telescope to an extent that exceeds the field curvature of a traditional Schmidt-Cassegrain telescope. If not, then using a focal-reducer with Celestron EdgeHD Schmidt telescopes and Meade LX200-ACF Series telescopes should be feasible even though that will result in losing edge-of-field sharpness.

Figure 2-27. Daytime photograph recorded using the 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope (SCT) with an f/6.3 focal-reducer resulting in an effective focal length and f-ratio of 945mm f/6.3. Without the focal-reducer, the magnification of this 1500mm telescope is too great for this distance. *Camera-to-subject distance:* 117 meters (128 yards). *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Method:* Prime-focus (direct coupling). *ISO:* 640. *Shutter speed:* 1/160 second. The upper image shows the approximate field-of-view that a crop-sensor digital single-lens reflex camera would provide with this telescope in this instance.

Understand that clandestine photographers break many rules of photography and sometimes use products in ways that manufacturers never intended, doing that to photograph under conditions unsuited for photography. Over time, the authors tried many things that tradition and product manufacturers said would not work but found that the methods did work. In many cases, unorthodox applications worked very well. Never be afraid to experiment and try unconventional methods. Remember that from the clandestine

photographer's perspective a reduced quality image containing information is better than no image.

High-Magnification SCTs are Very Fast Optical Systems!

There is a tendency to think of Schmidt-Cassegrain telescopes (SCTs) as being slow optical systems. Most are, after all, f/10. All the Meade SCTs are f/10 except for the 20″ Max (LX400-ACF) which is 4064mm f/8. All the Celestron SCTs are f/10 except for the C14, which is 3910mm f/11. Are these by any measure fast lenses? The fact is they are very fast! They are fast when considering their f-ratio (aperture) relative to focal length. This issue was previously addressed under the subheading *Ultra-Fast Telephoto Lenses.*

Stated earlier, whether a lens is fast or slow depends on its maximum aperture relative to its focal length. When viewed from this perspective, it becomes apparent that high-magnification SCTs are fast with their speed increasing as focal length increases relative to aperture. For example, a 4064mm f/10 SCT is much faster than a 2034mm f/10 SCT. Contemplate this interesting point. . . . If one could find a 5x tele-converter (none exist) to use with a Canon or Nikon 600mm f/4 telephoto lens, the effective focal length and f-ratio (aperture) would become 3000mm f/20. At f/20, the lens would be two stops slower than the 3048mm f/10 12″ Meade LX90-ACF telescope. Here is another point to ponder. The Canon EF 800mm f/5.6L IS USM super telephoto lens, when used with a 2x tele-converter features an effective focal length and f-ratio of 1600mm f/11.2. By comparison, the 2350mm f/10 Celestron C9.25″ SCT provides approximately 47 percent greater magnification and it is 1/3 stop faster. *Schmidt-Cassegrain telescopes are fast!*

TELESCOPE EYEPIECES

Using a telescope for direct viewing requires a telescope eyepiece (ocular). Using a telescope for afocal photography and for eyepiece projection photography also requires a telescope eyepiece. A telescope eyepiece is an optical device through which one views the image formed by the optical elements of the telescope. In the case of photography, the eyepiece provides an image to photograph. Whether used for direct viewing or for photography, the quality of the eyepiece matters.

Telescope eyepiece quality varies considerably and therefore price varies from inexpensive to very expensive. At the time of this writing, the price of telescope eyepieces ranges from as little as $20 (USD) to over $800 (USD). Inexpensive eyepieces feature only a few lens elements made using low quality optical glass, and they are not fully multicoated. Expensive eyepieces fea-

Figure 2-28. Telescope eyepieces feature various optical designs. The 25mm focal length Plössl eyepiece pictured here features four multicoated lens elements in two groups (two cemented doublets). Fully multicoated is better than multicoated. Some telescope eyepieces feature as many as eight lens elements. Plössl eyepieces are good all around performers although quality varies from poor to good depending on who made it.

ture several fully multicoated lens elements made using high quality optical glass (see Figure 2-28).

Eyepieces are a topic that readers must research if they decide to engage in afocal photography and/or eyepiece projection photography because suitability, quality, and prices vary considerably. For purposes of this discussion, it is sufficient to say that photographic applications require quality eyepieces featuring a long eye relief and wide field-of-view. Eye relief is the distance between the exit end of the eyepiece and the eye of the observer.

OpticsPlanet, Inc., a retailer of telescopes and accessories, offers advice regarding eyepiece quality and selection. At their Web page, a discourse titled *Ten top telescope eyepiece questions,* OpticsPlanet, Inc.[6] (2009, n.p.) offers the following advice:

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6. OpticsPlanet, Inc. Toll-Free Phone: 1.800.504.5897. Intl. Calls: 847.513.6201. Fax: 847.919.3003. Email: sales@opticsplanet.com. Website: www.opticsplanet.com. Address: 3150 Commercial Avenue, Northbrook, IL 60062.

Figure 2-29. The Zeiss Victory PhotoScope 85 T* FL is a combination 15-45x85 zoom spotting scope and sophisticated 7 megapixel digital camera in a rubber armored rainproof magnesium housing. The surveillance specialist operates the auto-focus camera using a wireless remote control. During picture taking, the LCD monitor may be open or closed. In the closed position, the specialist does not appear to be taking pictures. Image courtesy of Carl Zeiss Optical, Inc.

> In general, you pay more to get 1) better sharpness, not just at the center of the field, but also out to the very edge and 2) wider apparent fields of view. Telescope eyepieces that excel at both use complex lens systems of the highest quality and these do not come cheap. Using a premium eyepiece cannot always guarantee that you will see more, but using a premium eyepiece will always bring out the best in your telescope.

Chapter 4, *Techniques and Methods of Manual Clandestine Photography,* and Chapter 5, *Night Vision Photography for Clandestine Operations,* discusses and illustrates afocal photography and eyepiece use for that application.

CARL ZEISS VICTORY PHOTOSCOPE 85 T* FL

> The new Victory PhotoScope 85 T* FL is the world's first spotting scope with a zoom lens and a fully integrated 7 megapixels digital camera that permits simultaneous observation and photography. . . . You will . . . be able to see what you are photographing in crystal clear detail, unlike the dimmer images you would see through a DSLR with long telephoto lens. This is a new experience for both observers and photographers. (Carl Zeiss Optical, Inc., 2009, September 29, n.p., *Carl Zeiss announces the Victory PhotoScope 85 T* FL*).

A recent innovation of interest to clandestine photographers is the Carl Zeiss Victory PhotoScope 85 T* FL (see Figure 2-29). This 15-45x85 spotting

scope features a built-in 7 megapixels digital camera. As such, this photo-optical system is, in essence, a 93-280mm f/2.4-3.3 telephoto zoom lens with a built-in crop-sensor digital camera. The size of the CCD image sensor results in a 35mm equivalent focal length of 600-1800mm relative to angle-of-view. Because the PhotoScope features a maximum ISO of 800, it is primarily a daylight system but suitable for use in artificially illuminated nighttime environments. Visit the Carl Zeiss website for complete and current information.

FOCAL LENGTH CONVERSION FACTOR

The focal length of the lens and the dimensions of the image sensor working together determine angle-of-view and thus the field-of-view.

Digital Single-Lens Reflex Camera–Conversion Factor

When a greater telephoto capability is required, achieve that by increasing focal length. It is not achievable by reducing image sensor size. When placing a crop-sensor DSLR camera onto a telephoto lens made for full-frame DSLR cameras, image size does not increase–field-of-view decreases! Nick Rains (2002, n.p.) addresses this issue explaining that, "when you put a 300mm lens on a D60 you do NOT get a 480mm lens–it is still a 300mm lens. What has changed is the format of the camera–from 36x24mm film to a 22.7x15mm chip."

Focal length conversion factor, focal length multiplier, lens conversion factor, magnification factor, field-of-view crop factor, and 35mm equivalent focal length are all familiar terms that mean the same thing. They pertain to the cropped field-of-view that results when placing a full-frame DSLR camera lens onto a crop-sensor DSLR camera. The terms appear also in reference to digital pocket cameras, digital bridge cameras, and camcorders.

Many photographers incorrectly believe that a lens made for a full-frame DSLR camera provides greater magnification when used with a crop-sensor DSLR camera, that it becomes a more powerful telephoto lens. The fact is, when using a crop-sensor DSLR camera with a telephoto lens made for a full-frame DSLR camera, magnification does not increase. The only change that occurs is a reduction of the angle-of-view, which results in reduced field-of-view. Both diminish because the smaller image sensor of the crop-sensor DSLR camera captures only the central area of the image provided by the lens. Magnification "appears" greater because the image is larger relative to the smaller frame.

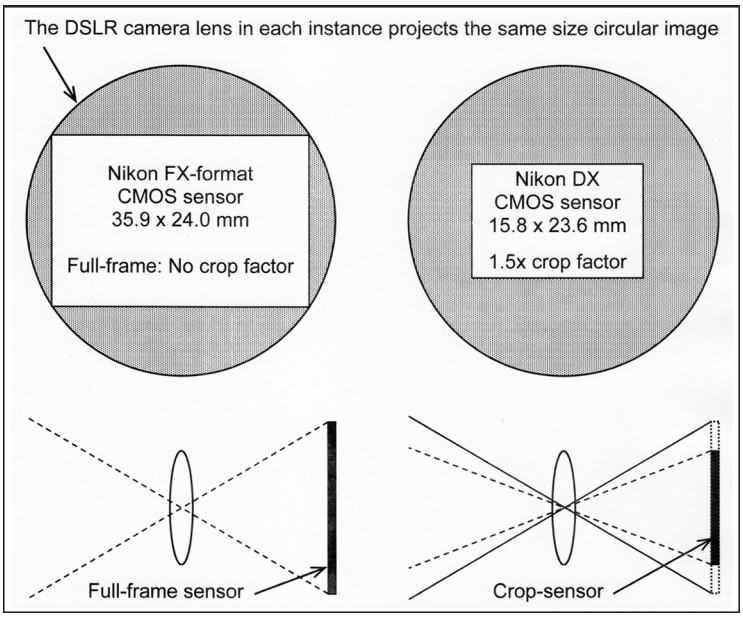

Figure 2-30. The focal length of the lens and the dimensions of the image sensor working together determine angle-of-view and thus the field-of-view. With the same focal length lens, a large image sensor provides a wider angle-of-view than a small image sensor does. The smaller image sensor causes reduced field-of-view by recording a smaller portion of the image circle provided by the lens. The smaller image sensor records a "cropped" image. It is that circumstance underscoring the so-called 35mm equivalent focal length of a lens when used on a camera containing an image sensor smaller than 36 x 24 millimeters. In reality, the situation is one of equivalent angle-of-view, not equivalent focal length or equivalent magnification. Stated another way, so-called 35mm equivalent focal length is *not* a case of equivalent focal length in terms of millimeters, or equivalent image magnification, or equivalent image detail. It pertains to angle-of-view only!

If you have a full-frame DSLR camera and an assortment of telephoto lenses, do not purchase a crop-sensor DSLR camera believing it will make the lenses more powerful. It will not–the crop-sensor camera will not increase a lens's magnification or telephoto capability. As stated, the camera's smaller image sensor records only the central area of the image circle provided by the lens and thereby it reduces angle-of-view. Reduced angle-of-view reduces field-of-view. Reduced field-of-view creates the *illusion* of greater magnification. Stated above but too important to not repeat, *magnification appears greater because objects within the scene are larger relative to the reduced area of the frame* (see Figures 2-30 to 2-32).

When camera-to-subject distance is great, a diminished field-of-view usually presents no problem. Diminished field-of-view is not a problem because

Figure 2-31. Nighttime images recorded using ambient artificial illumination. Camera-to-subject distance is 214.88 meters (235 yards). The surveillance specialist recorded these images using a full-frame and a crop-sensor digital single-lens reflex (DSLR) camera in turn. While recording these images, the Canon EF 600mm f/4L IS USM telephoto lens remained tripod mounted. The specialist simply changed cameras. Image size is the same in each instance but the frame area is different; the crop-sensor frame area is less, which makes it appear that a stronger telephoto lens recorded the image. The reduced frame area creates the illusion of greater magnification. *Upper image:* Un-cropped image recorded using a crop-sensor DSLR camera featuring a 1.6x focal length conversion factor (Canon EOS 30D DSLR camera). *Lower image:* Uncropped image recorded using a full-frame DSLR camera (Canon EOS 5D DSLR camera). These scaled images illustrate why a telephoto lens on a crop-sensor camera *appears* to be a stronger telephoto lens. In fact, whether on a full-frame camera or a crop-sensor camera, the lens provides the same size image. All that changes is the smaller image sensor of the crop-sensor camera records only the central area of the image provided by the lens–it records a "cropped" image. Objects are larger only relative to the reduced image area. *Note:* The challenge when photographing this subject was the backlighting created by the interior lights of the market. Nevertheless, subject identification is excellent and the vehicle number plate is legible as the next illustration shows.

Figure 2-32. This is a cropped portion of the subject appearing in the lower image of the previous illustration. The detail in this image attests to the fact that one can do quality manual clandestine photography at night under low ambient artificial illumination using high ISO, in spite of backlighting. The challenge when photographing this subject was the backlighting created by the interior lights of the market. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 600mm f/4L IS USM super telephoto lens. *ISO:* 3200. *Exposure time:* 1/80th second. *F-Ratio (aperture):* f/4. *Time:* Night. *Lighting:* Typical for a gasoline service station market.

the great distance results in ample field-of-view. At shorter camera-to-subject distances, diminished field-of-view can be a problem. Revisit Figure 2-31 and contemplate the reduced field-of-view issue.

Summary. When placing a full-frame telephoto lens onto a crop-sensor camera, image size does not increase–field-of-view decreases! The surveillance specialist must understand this principle. When a greater telephoto capability is required, achieve that by increasing focal length. It is not achievable by reducing image sensor size.

Camcorders–Conversion Factor

In reality, the situation is one of equivalent angle-of-view. So-called 35mm equivalent focal length is not a case of equivalent focal length in terms of millimeters, or equivalent image magnification, or equivalent image detail. It pertains to angle-of-view only!

The previous discussion emphasized that removing a full-frame DSLR camera from a telephoto lens and replacing it with a crop-sensor DSLR camera results in reduced angle-of-view, not increased magnification. The same situation applies to camcorders.

Camcorders feature comparatively short focal length lenses yet many provide a very high 35mm equivalent focal length. That occurs because camcorders contain very small image sensors; a small image sensor results in a narrow angle-of-view. For example, the 6.1-61 millimeter zoom lens on the Canon VIXIA HV30 camcorder featured in this book boasts a 35mm equivalent zoom range of 43.6–436 millimeters (refer ahead to Figure 2-34). That impressive 35mm equivalent focal length pertains to equivalent angle-of-view not equivalent magnification.

Comparing various camcorder models for clandestine use is easier when one understands how focal length and image sensor size work together to determine angle-of-view. The understanding prevents selecting one model camcorder over another believing that it features a greater telephoto capability when it may not. Consider the following comparison of the Sanyo VPC-TH1 HD high-definition camcorder and the Canon VIXIA HF S11 high-definition camcorder. Both are good camcorders–this comparison is only from the perspective of clandestine applications.

The technical specifications for the Sanyo camcorder indicate that its zoom lens features a 35mm equivalent focal length of 43-1290 millimeters. By comparison, the technical specifications for the Canon camcorder indicate that its zoom lens features a 35mm equivalent focal length of only 43.5–435 millimeters. On that basis, it appears that the Sanyo features a greater telephoto reach and therefore represents the better choice for manual clandestine videography.

While the Sanyo camcorder features a greater maximum focal length lens, 75mm, versus the Canon's 64mm lens, the image sensor of the Sanyo is considerably smaller than the image sensor of the Canon. The Sanyo camcorder's narrower angle-of-view and thus greater 35mm equivalent focal length is more the result of the smaller image sensor than it is the maximum focal length of the lens (see Figure 2-33).

Determine a camcorder's focal length conversion factor by ascertaining the type of image sensor that the camcorder contains. Then, determine the diagonal measurement of the sensor in millimeters. Finally, divide 43.27 (full-frame sensor diagonal measurement) by the diagonal of the camcorder's sensor–the quotient is the focal length conversion factor.

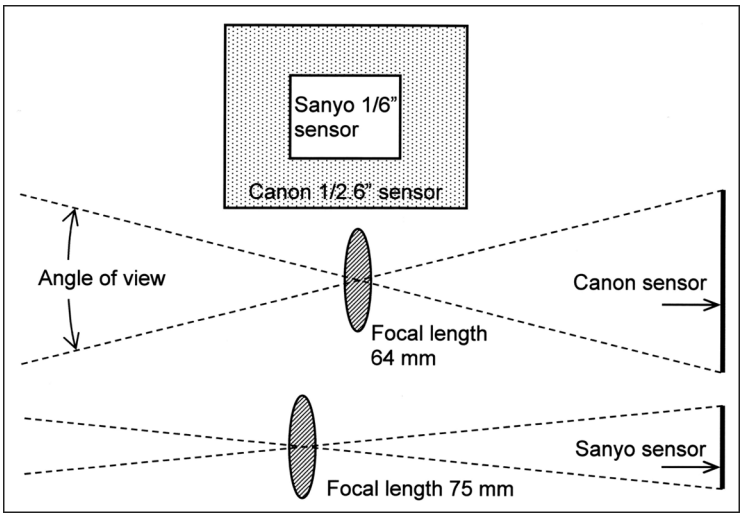

Figure 2-33. This reasonably scaled drawing shows that the Sanyo VPC-TH1 HD camcorder angle-of-view being narrower than that of the Canon VIXIA HF S11 camcorder is more the result of a much smaller image sensor than it is the maximum focal length of the lens.

CAMCORDERS

Introduction

> Camcorders can record subject activity uninterrupted for an extended period, one hour or more.
>
> You gotta' love the rapid pace at which technology is advancing. Prosumer video cameras today can be even better than some of the professional cameras of only a few years ago, and the line between prosumer and professional keeps blurring more and more each year. (Lehrer, Moshe, 2010, n.p.)

During clandestine operations, recording subject activity often is essential and for that task, the surveillance specialist uses a camcorder or a DSLR camera in video capture mode. Using a camcorder, the specialist can record subject activity uninterrupted for an extended period from close range and from long distances. With an appropriate camcorder, the specialist can document subject activity from as close as the next table in a restaurant or bar, or from as far as 1.61 kilometer (1 mile), or more.

The retail market offers a variety of camcorder models. Depending on need, the surveillance specialist uses a consumer grade, prosumer, or professional grade camcorder. Consumer grade camcorders emphasize automation

(ease of operation), miniaturization, and comparatively low equipment cost (see Figure 2-34). In comparison to consumer grade camcorders, prosumer and professional grade camcorders are larger and more expensive and although they provide automated features, they permit manual control, which is necessary in some instances (see Figure 2-35).

When considering camcorders for investigative and intelligence collection applications, scrutinize the features of professional grade camcorders and consider their usefulness relative to manual clandestine photography. Consider, for example, the dual card feature of the JVC HM790U professional grade camcorder that permits uninterrupted recording for an indefinite time. As B & H Foto & Electronics Corporation explains, "The camera automatically starts recording to the second card when the first is full, and then switches back to the first when the second is full, so as long as you continue to replace full cards with empty ones, you can get virtually unlimited recording time" (B & H Foto & Electronics Corporation, 2010, n.p., *JVC HM790U: Indoors and Out*).

When an operation requires recording moving video images, consider mounting two camcorders side-by-side (refer to Figure 4-39 in Chapter 4, Figure 5-13 in Chapter 5, and Figure 6-35 in Chapter 6 to view side-by-side mounting methods). The advantages of mounting two camcorders side-by-side include, but are not limited to, the following:

- *Redundancy–emergency backup video.* Should one camcorder fail the other camcorder continues to record essential activity. When operating a second camcorder to create an emergency backup video, the two camcorders need not be the same make and model. For example, the primary camcorder may be a professional grade camcorder with the secondary camcorder being consumer grade.
- *Differing fields of view.* One camcorder records a wide view of the subject area while the second camcorder records a close-in telephoto view of the subject's activity.
- *Uninterrupted recording.* Use two camcorders of the same make and model mounted side-by-side with the zoom lens covering the same field-of-view. When the recording medium of the operating camcorder is nearing capacity, the surveillance specialist activates the second camcorder and then deactivates the first. Once deactivating the first camcorder the specialist replaces the recording medium. The specialist repeats that process during the course of surveillance.
- *An emergency backup camcorder is in place but not active.* The primary camcorder records subject activity with the second camcorder activated only in the event the primary camcorder fails.

Figure 2-34. The Canon VIXIA HV30 high-definition (HD) consumer grade camcorder accepts a 1.7x afocal tele-converter lens that mounts in front of the permanently installed zoom lens. Mounting the tele-converter lens to this particular camcorder requires no adapter ring–it screws directly to the 43mm filter threads. This camcorder features a 6.1-61 millimeter f/1.8-3.0 10x optical zoom lens. When fitted with the 1.7x TL-H43 tele-converter, the lens system becomes 10.37-103.7 millimeters f/3.06-5.1. With the tele-converter lens in place, at full zoom this camcorder features a 35mm equivalent focal length of 741 millimeters. *Equivalent focal length pertains to angle-of-view not magnification!* From a distance of 274 meters (300 yards), at full zoom using the 1.7x tele-converter, this camcorder records subject identification (i.e., facial recognition) and legible vehicle number plates. If greater magnification is necessary, using a longer focal length lens by means of afocal coupling is required (refer to Figures 4-41 and 4-42 in Chapter 4). This camcorder features the 1/2.7″ CMOS image sensor giving it a focal length conversion factor of 7.15x. This camcorder date and time stamps the images as all camcorders used for clandestine applications should. One private investigator films the screen display of his cell phone at the beginning and end of each physical surveillance operation wherein he uses a camcorder. He does that to verify correct date and time stamp settings.

Figure 2-35. A fluid head on the Kirk Multi-Purpose Window Mount supports this MiniDV format Canon XL2 professional camcorder. This sophisticated camcorder provides the surveillance specialist with total control of camcorder functions. This camcorder features lens interchangeability, shown here with the 5.4-108 millimeter f/1.6-3.5 20x OIS (optical image stabilized) zoom lens. Among other features, the XL2 offers variable frame rates, wireless remote control, remote computer camera control, direct video recording to a computer, and autofocus with manual focus override. This standard definition camcorder features a 1/3″ 3 CCD image sensor system. Minimum illumination requirement is 5.5 lux. Weight is 3.5 kilograms (7.8 pounds).

- *Conventional camcorder and DSLR camera in video capture mode operate simultaneously.* The conventional camcorder records the general area of the scene while the DSLR camera in high-definition video capture mode records close-up high-detail moving video images.

Zoom Lens Range

Maximum focal length not zoom range determines the telephoto capability of a camcorder. When selecting a camcorder for clandestine videography place emphasis on maximum focal length, not maximum zoom range.

Most high quality camcorders feature a zoom lens. Is a 30x zoom lens more powerful than a 20x zoom lens? Does a 30x zoom lens provide a greater telephoto capability than a 20x zoom lens? It may, but it may not. The zoom range is a ratio determined by dividing the maximum focal length of the lens by the minimum focal length of the lens. The quotient is the zoom

range. For example, the Canon VIXIA HV30 camcorder illustrated in Figure 2-34 features a 6.1–61 millimeter 10x zoom lens. Divide the maximum focal length of 61 mm by the minimum focal length of 6.1 mm and the quotient of 10 indicates the zoom range of the lens (61 ÷ 6.1 = 10). When selecting a camcorder for clandestine videography place emphasis on maximum focal length, not maximum zoom range. Really, the zoom range is irrelevant, but maximum focal length and image sensor size does matter. Select a long maximum focal length and large image sensor.

Image Stabilization

Image stabilization is a desirable feature when handholding a camcorder, especially when working in low-light conditions or filming from a moving platform such as a watercraft, aircraft, or land vehicle.

Optical image stabilization is preferred over digital stabilization. Optical image stabilization technologies vary in operational detail although generally they are hardware based and operate by means of a built-in gyrosensor and microprocessor. The gyrosensor and microprocessor work together to neutralize camera and lens movement. Optical image stabilization is true image stabilization.

Digital image stabilization is not true image stabilization; it only creates the illusion of stabilization. Digital stabilization prevents movement from causing image blur by increasing the shutter speed. The camcorder increases shutter speed by increasing ISO and that degrades image quality by adding electronic noise. Increasing ISO is especially detrimental when using a camcorder with an image intensifier night vision device.[7]

Some cameras featuring digital image stabilization also feature internal processing to correct for image blur. Internal processing improves image quality in much the same manner that a graphics-editing program such as Adobe® Photoshop® does during postphotography editing. For the clandestine photographer who must capture the best quality images possible, increased ISO and in-camera processing are not suitable alternatives to optical image stabilization.

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7. When using an image intensifier night vision device (NVD) for photography and videography, the level of nighttime illumination determines the extent that increased ISO degrades image quality. When nighttime illumination is strong, such as on a clear night with a full moon and bright starlight, increasing ISO does not degrade image quality as badly. On a dark night with little illumination from the moon and stars, increasing ISO quickly degrades image quality. Increasing the gain level of an NVD also degrades image quality. In fact, increasing NVD gain degrades image quality more quickly than increasing ISO does.

Some camcorders feature a dual stabilization system wherein optical image stabilization and digital image stabilization work together. A dual system is better than purely digital stabilization and has merit for available light filming. When filming with a night vision device, however, the surveillance specialist benefits by having complete control of ISO. Chapter 5, *Night Vision Photography for Clandestine Operations,* provides an illustrated discussion of these issues.

Selecting a Camcorder

When purchasing a camcorder for clandestine use, place emphasis on image sensor size and maximum focal length. Favor camcorders featuring a large image sensor and long focal length lens.

Camcorder technology is advancing rapidly so research the market before making a camcorder selection. Let product research include consulting sources such as Consumer Reports, IntelliReview, Consumer Search, Epinions, and Amazon. When selecting a camcorder for manual clandestine videography, things to consider include but are not limited to the following:

- Need determines the most suitable camcorder selection. Clarify the intended application of the camcorder before making a selection.
- The reputation of the manufacturer relative to product quality and commitment to customer satisfaction is important.
- High-definition is preferred over standard definition.
- Recording media selection is important–technology advances rapidly so research this issue. Select media consistent with the latest technology and according to the intended camcorder application.
- Recording file formats / Storage format. Determine which storage format will best serve needs.
- Maximum filming duration must be consistent with the intended use of the camcorder.
- The ability to control ISO by means of manual override is a valuable feature, especially when using the camcorder with an image intensifier night vision device.
- Optical image stabilization is preferred over digital stabilization.
- Image sensor size–generally, larger is better.
- For surveillance, maximum optical focal length of the lens is important.
- Some camcorders feature a greater 35mm equivalent focal length than other camcorders do not because the lens features greater focal length, but because the image sensor is smaller. Instead of placing emphasis

on the 35mm equivalent focal length, place emphasis on the actual optical focal length of the lens.
- Optical zoom is superior to digital zoom. Nevertheless, digital zoom provides some benefit such as achieving desired area of coverage. Digital zoom works better with high-definition camcorders.
- The aperture of the lens at full optical zoom is important for low-light situations.
- Tele-converter lenses increase camcorder versatility, but extender lenses are not available for all camcorders.
- Focus. Most consumer-grade camcorders feature auto-focus. Manual override for focus is a desirable feature.
- Exposure control. Most consumer-grade camcorders feature auto exposure with no provision for manual override. Manual override for exposure control is useful for difficult lighting situations.
- Low-light sensitivity. Camcorder specifications often identify the minimum illumination requirement in terms of lux. Regard minimum lux figures with skepticism because some camcorders perform better at the reported minimum lux than others do. If economics permit, acquire 4 to 5 camcorders that appear appropriate for manual clandestine videography under low-light conditions and perform in-field comparisons of their low-light performance. Consult product reviews and, if available, rent camcorders for this evaluation.
- Consider megabits per second (Mbps) transfer rate of the camcorder under consideration.
- Date and time stamp is an important feature.

During clandestine videography, favor manual focus. With auto-focus, one cannot photograph through windows. Additionally, other objects such as people and vehicles entering the field-of-view can capture auto-focus resulting in the subject being out of focus. Focus lock is a desirable feature.

When using a camcorder in low-light environments, consider viewing the subject by means of the eyelevel viewfinder rather than the LCD monitor. In some instances, when working in the dark the light from the LCD monitor can alert a wary subject. Another reason for viewing the subject by means of the viewfinder is extension of battery life. When the camcorder is on a support system, use the LCD monitor during the setup process if desired, but close it once achieving proper framing of the subject area. That eliminates light emanating from the LCD monitor for the duration of filming and it extends the life of the battery.

BASIC PHOTO-SURVEILLANCE PACKAGE

Surveillance Photography on a Budget

Every field agent should be capable of general surveillance photography and videography using off-the-shelf equipment. Nevertheless, advanced photography teams are necessary to handle challenging situations. Specialist teams are necessary to handle extreme camera-to-subject distances, low-light situations, and circumstances requiring use of image intensifier night vision devices for photography and videography.

With the following moderate cost equipment, every field agent can do respectable short to intermediate range manual clandestine photography and videography without an advanced level of photographic expertise (see Figure 2-36). Over time, camera models change as new models become available so view the equipment illustrated here as examples. The emphasis is on minimizing equipment and training costs. Consider a crop-sensor DSLR camera that is capable of recording high-definition (HD) video. Minimizing cost is also the reason for suggesting a consumer grade camcorder rather than a prosumer or professional grade model. Stated earlier, at full zoom with the 1.7x extender lens, this camcorder can record recognizable images of people and legible vehicle number plates from a distance as great as 274 meters (300 yards).

Some products are expensive and no low-cost alternatives exist. Nevertheless, the surveillance specialist can sometimes economize by mixing low- and high-cost products (see Figure 2-37). In that instance, the specialist economized by using the Special-Order Battery-Adapted AstroScope with a quality apochromatic (APO) refractor telescope and a crop-sensor digital single-lens reflex (DSLR) camera.

The refractor telescope in the above image is a true apochromatic (APO) triplet featuring three fully multicoated lens elements made using extremely low dispersion glass that exhibits almost no color fringing. It weighs 2.8 kilograms (6.2 pounds), measures 38.1 centimeters (15 inches) in length, and features an extendable lens shade. The machined 2″ (50.8 mm) dual speed Crayford style focuser works superbly for precise focusing (refer to Figure 4-13b in Chapter 4 to view additional images recorded using this telescope).

The authors use both full-frame and crop-sensor DSLR cameras with good results. In fact, they use what is now an old and no longer manufactured crop-sensor camera, the Canon EOS 30D that has proven to be a rugged and reliable workhorse. The colloquial term “workhorse” has many meanings, one of which is “Something, such as a machine, that performs

Figure 2-36. This basic and cost-effective photo-surveillance package enables field agents to do respectable short- to intermediate-range manual clandestine photography and videography without a high level of photographic expertise. *Left to right:* • Canon PowerShot SX210 IS digital pocket camera for foot surveillance and other close to moderate range applications • Canon VIXIA HV30 consumer grade camcorder with the 1.7x extender lens • Canon EF 200mm f/2.8L II USM telephoto lens for low-light photography • Canon EOS Rebel T3i crop-sensor DSLR camera sporting the Canon EF 75-300mm f/4-5.6 III auto-focus zoom lens. This Canon Rebel records high-definition (HD) video, the Nikon D5100 DSLR camera offering comparable features.

dependably under heavy or prolonged use. . .” (*The American Heritage® Dictionary of the English Language, Fourth Edition,* n.d., *Workhorse*).

In addition to the above photographic equipment, surveillance specialists should have the following items.

- Binocular (consider only high quality models).
  - Carl Zeiss Victory FL 8x56 T* binocular for day and night use.
  - Use the Carl Zeiss Conquest 8x56 T* binocular in lieu of the Victory if budget is a limiting factor.
  - Carl Zeiss Victory Compact 8x20 T* binocular for discrete daytime viewing. This binocular folds small enough to carry in the pocket of a shirt or blouse and women can easily carry it in a purse.
- Spotting scope (consider only high quality models).
  - Leupold Mark 4 12-40x60 Tactical Spotting Scope.
  - Carl Zeiss Victory DiaScope 15-45x65 T* FL Spotting Scope.
  - Carl Zeiss Victory DiaScope 20-60x85 T* FL Spotting Scope.

Figure 2-37. At night, from a distance of 214.88 meters (235 yards), the surveillance specialist photographed this vehicle using the night vision system pictured here. The photographic assembly consists of the Canon EOS 30D digital single-lens reflex crop-sensor camera, Special-Order Battery-Adapted AstroScope night vision module, 480mm f/6 Meade Series 5000 ED 80mm APO Apochromatic Refractor telescope (3 lens elements), and Morovision Roc Stoc™ Tactical Shoulder Stock Rail Interface system. At f/6, this telescope is approximately 1 1/3 stops slower than the 500mm f/4 Canon and Nikon telephoto lenses (specifically 1.1699 stops slower). *ISO:* 100. *Shutter speed:* 1/10 second. *Illumination:* Natural nighttime illumination and a distant streetlight. With unaided vision, one could detect the presence of the vehicle but not discern with confidence that it was a vehicle. If purchasing the Roc Stoc™ for use with a DSLR camera, specify the model featuring a built-in 2-position trigger for auto-focus and shutter release.

- Laser rangefinder.
- Miscellaneous support systems such as but not limited to tripods and window mounts for cameras, binoculars, spotting scopes, and laser rangefinders.

PERSONAL USE OF AGENCY-ISSUED PHOTOGRAPHIC EQUIPMENT

Photography and videography are perishable skills requiring frequent practice.

The following are thoughts about agency-issued photographic equipment, the merits of which to consider. Authorizing personal use of an agency-issued camera and camcorder seems to be sensible. It acknowledges that photography and videography are essential but perishable skills requiring frequent practice. Authorizing personal use recognizes that lack of comfort with equipment results in disuse of the equipment, or lack of proficiency when using it. Competence breeds confidence and enthusiasm, which results in agents embracing rather than resisting use of the equipment.

Two issues underscore the failure by agents to apply newly learned skills and use unfamiliar equipment. First, people are creatures of habit and to varying degrees resist change. They find comfort to doing things the old familiar way. Second, until agents have practiced newly acquired skills and become proficient, confidence is lacking. In many instances, the need for photographic equipment is sporadic and that coupled with the fact that photography and videography are perishable skills results in a predictable reluctance to use the equipment. In those instances when equipment is used, lack of practice may result in substandard proficiency.

Competence leads to confidence and for that reason consider authorizing personal use of agency-issued photographic equipment. True, personal use can diminish the useful life of the equipment but that is less costly than having equipment remain in the case unused. Authorizing personal use is also less costly than lack of proficiency resulting in an inferior work product (i.e., low quality or unusable images). Encourage agents to use the equipment to photograph and video record personal events such as, but not limited to, their child's birthday party, family picnic, and trip to the beach.

Many agents have personal cameras, DSLR cameras and camcorders, and they are proficient in their use. Nevertheless, they must be comfortable with the operation of equipment that the agency provides. A person comfortable with a Canon DSLR camera will lack comfort when using an unfa-

miliar Nikon DSLR camera, for example. The same is true for camcorders. Agents must be proficient with agency-issued equipment.

Naturally, responsibility accompanies personal use of agency issued equipment. After personal use of the equipment, the agent must return it to the case ready for the job (i.e., freshly charged batteries and fresh recording medium). If equipment is normally in the vehicle, they must return it to the vehicle to prevent forgetting it at home when returning to work. Personal use of the equipment cannot interfere with the required state of readiness.

Chapter 3

PHOTOGRAPHIC ACCESSORIES FOR MANUAL CLANDESTINE PHOTOGRAPHY

Some products that are essential for manual clandestine photography are not available on the commercial market. Astro-photographers face a similar situation and that is why many observatories and advanced amateur astronomers have a machine shop or they contract with machinists to make products they need but cannot purchase. The serious clandestine photographer should do likewise.

INTRODUCTION

In addition to appropriate cameras and lenses, the surveillance specialist needs a variety of photographic accessories. Many accessories are available on the commercial market, but the specialized nature of some accessories requires designing and manufacturing them as needed on a one-off basis. Like many observatories and advanced amateur astronomers, the surveillance specialist needs the means to make specialty accessories as the need for them becomes apparent. In the absence of an in-house machine shop, contracting with a machinist to fabricate specialty accessories is necessary.

The custom accessories appearing in this book are in-house fabricated author inventions. They perform well but without doubt, some readers will find ways to improve them. It is unfortunate that some accessories are too specialized to survive as commercially manufactured products. For some products, low sales volume would not justify the costs of design, manufacturing, and marketing.

ORGANIZING CAMERAS, LENSES, ACCESSORIES, AND TOOLS

In the field, the surveillance specialist must have all required equipment but nothing more. Photographers and videographers use a variety of bags, cases, backpacks, and vests and the surveillance specialist should do likewise.

Backpacks of various sizes constructed specifically for photographers and videographers are available from a variety of manufacturers, many being water resistant. Common backpack features include, but are not limited to, padded protection, adjustable dividers, outer storage pockets, tripod straps, and a built-in weather cover. Many medium and large size backpacks feature a compartment for a laptop computer. During photographic surveillance, the specialist can work from a backpack or from a camera bag. If unfamiliar with camera bags, research the topic.

During photographic surveillance when various accessories and tools must be readily available, extra clothing pockets are useful and in some instances essential. The need for multiple pockets is why many photographers and videographers wear a photo/video vest.

MANFROTTO 293 TELEPHOTO LENS SUPPORT and 360-DEGREE ROTATION BASE

When using a short to medium telephoto lens lacking a rotation collar and therefore lacking a tripod mount (foot), attach the camera and lens to the Manfrotto 293 Telephoto Lens Support (see Figure 3-1).

TRIPODS and HEADS

> High quality photographic images are the result of accurate focus, proper exposure, and lack of camera movement at the time of exposure. A failure in any of these areas results in diminished image quality.

Introduction

The above epigraph leaves it clear that a number of factors contribute to high quality photographic images. Improper exposure degrades image quality, an out-of-focus picture is unclear, and camera movement, at the time of exposure can result in a blurred image. A sufficiently fast shutter speed compensates for camera movement, but a fast shutter speed is not always possible during manual clandestine photography. Frequently, the surveillance

Figure 3-1. Many short to medium telephoto lenses feature no rotation collar and therefore they lack a tripod mount (foot). The Manfrotto 293 Telephoto Lens Support permits mounting such lenses to a tripod or other camera support. *Top down:* Canon EF 200mm f/2.8L II USM telephoto lens and digital single-lens reflex camera; Manfrotto 293 Telephoto Lens Support; Manfrotto 234RC Monopod Head Quick Release; author-invented 360-degree rotation base; Manfrotto Car Window Pod 243 (window mount). The 360-degree rotation base and tilt feature of the 234RC Monopod Head, working together, are a Gimbal style support. Unfortunately, for this application, the overall height of the apparatus is too great for use in passenger cars, but it works well with pick-up trucks, jeeps, SUVs, and minivans, depending on model. If somebody designs a commercial rotation base, the hope is they will make it about one-third the height of the one pictured here–the lower the profile the better.

specialist needs a sturdy tripod or some other suitable camera support.

Surveillance specialists frequently record photographic images using high-magnification telephoto lenses and telescopes with and without an image

intensifier night vision device (NVD). High magnification amplifies vibrations, which is problematic when using a slow shutter speed; clandestine photography often occurs under conditions requiring a slow shutter speed (e.g., available light photography under low-light conditions and photography using an image intensifier NVD). When using a slow shutter speed with high magnification, stability of the photographic apparatus is essential.

Tripods provide essential stability when using high-magnification optical systems and when using a slow shutter speed. Surveillance specialists use tripods to support everything from cameras to telephoto lenses, telescopes, spotting scopes, binoculars, laser rangefinders, and infrared (IR) illuminators. Although tripods are essential, many specialists feel that the head is more important than the tripod. Any robust tripod will work, but the head is what provides control of the equipment.

Tripods

Many tripods feature a leveling bubble integrated on the top plate, which is a useful feature.

The technical specifications for each tripod indicate its load capacity, the weight the tripod will reliably support. Before selecting a tripod, determine the weight of the heaviest equipment the tripod will support, and add the weight of the tripod head. Then, select a tripod featuring an appropriate load capacity.

Low-cost tripods come equipped with a nonremovable head, while higher quality tripods are sold with no head; one purchases the tripod and head separately. The reason for this is the wide variety of heads available; photographers select heads according to preference and need. Because tripods and heads are interchangeable, an equal number of heads and tripods usually are not necessary.

Tripod manufacturers construct tripods using wood, aluminum, basalt, or carbon fiber. For manual clandestine photography, consider aluminum, basalt, and carbon fiber, but not wood. Wood tripods are excellent but being heavy and vulnerable to moisture, one usually finds them in photography studios. They are best suited for indoor use.

Carbon fiber tripods weigh the least but they are the most expensive. Benefits provided by carbon fiber tripods include the following:

- Carbon fiber tripods weigh approximately 30 percent less than aluminum tripods with a comparable load capacity. Reduced weight is desirable when carrying a tripod to a remote rural site. Unfortunately, tripod weight being less leaves it less resistant to wind induced move-

ment. Greater weight is good for stability but not for portability. Determine tripod needs before making a purchase. Most surveillance specialists own more than one tripod and use each according to case specific needs.

- Carbon fiber tripods feature an excellent strength-to-weight ratio.
- In comparison to aluminum, carbon fiber tripods feature superior vibration suppression characteristics.
- Carbon fiber tripods are corrosion resistant.
- Carbon fiber tripods are quieter than aluminum tripods during setup and takedown and they do not produce a telltale metallic sound.
- Carbon fiber tripods are more comfortable to handle during cold weather than aluminum tripods are. Nevertheless, when using any tripod during cold weather, consider applying leg protectors/warmers. Tripod leg protectors are padded covers applied to the upper section of the tripod legs. The protectors insulate the hands from the cold of the tripod and they protect the tripod. They also reduce sound emission during transport and during use (refer to Figure 7-11 in Chapter 7).

Carbon fiber tripods, in comparison to equivalent load-capacity aluminum tripods, weigh approximately 30 percent less, as stated. Bogen Imaging, Inc. explains that, "Manfrotto's carbon fiber tubing is popular among outdoor photographers because it's light in weight, but . . . more rigid and supports heavier loads than aluminum–giving it a double advantage" (Bogen Imaging, Inc., 2010, n.p., *Manfrotto 4-Section Carbon Fiber Tripod*).

Gitzo provides some tripod models featuring leg tubes made of basalt fiber. Basalt fiber is approximately 20 percent lighter than aluminum, less expensive than carbon fiber, and offers most of the performance characteristics of carbon fiber. Basalt, therefore, relative to performance and price, is a compromise between aluminum and carbon fiber.

When selecting a tripod, consider available features relative to intended use. For example, is a *rapid* center column suitable or do needs require a geared center column featuring a rack and pinion gear system for precise height adjustment? Determine also if minimum and maximum height is important. If air travel is frequent, obtain at least one carbon fiber traveler series tripod–they are lightweight and very compact when collapsed. A traveler series tripod is also useful for in vehicle use but load capacity is limited. Load capacity varies by model.

Virtually all tripods feature individually adjustable leg length. Some tripods feature three-section telescoping legs and some feature four-section telescoping legs. Adjustable leg length provides three advantages. First, they col-

lapse to a short length for transport and storage. Second, they permit making height adjustments during use. Third, they permit adjusting leg length to accommodate uneven surfaces. More leg sections permitting collapse to a shorter length is a useful feature when using a tripod within a motor vehicle.

Tripod Heads

> Magnesium, the world's lightest structural metal, is approximately 33–35 percent lighter than aluminum. When obtaining a carbon fiber tripod for the benefit of minimum weight, consider using it with a magnesium head.

Introduction

Tripods, which support the head, are important. Nevertheless, many surveillance specialists feel that head selection is more important than tripod selection. Any sufficiently sturdy tripod will work, but the head is what provides control of the camera and lens assembly.

Manufacturers provide a variety of tripod heads from which to choose. Tripod heads are frequently referred to simply as heads. Because the head is so important, surveillance specialists need to be aware of the different types of heads to make an appropriate selection. When using a camcorder, surveillance specialists commonly use a fluid head because they permit slow smooth movement of the camcorder–no jerky movements. For still photography, specialists use a variety of conventional heads and they use fluid heads.

Heads, like tripods, feature a specified load capacity. The load capacity of tripod heads varies considerably, ranging from as little as 0.9 kilograms (2 pounds) to as much as 109 kilograms (240 pounds). Select a head rated for the weight it must support.

Using a tripod and head featuring a load capacity greater than the weight they must support means transporting extra weight, but that is necessary. Do not challenge the load capacity of a tripod and head! A wildlife photographer explained that during super telephoto photography she uses a tripod and head with a load capacity at least 4.55 kilograms (10 pounds) greater than the combined weight of her camera and lens. When using a lower weight camera and lens, a safety margin less than 4.55 kilograms (10 pounds) is adequate.

The following are common head types presented first in bullet fashion and then briefly elaborated upon in the same order. They are:

- Two-Way Head
- Three-Way Head

- Ball Head
- Gearhead–Geared Head
- Fluid Head
- Wimberley Head Version II™

Two-Way Head

Two-way heads are the most basic of all the head types and they are useful for manual clandestine photography. Two-way heads are simple, stable, and they support weight well. Two-way heads permit pan and tilt adjustments (e.g., moving the lens up and down vertically and left to right horizontally). This head is appropriate for still cameras, spotting scopes, binoculars, laser rangefinders, and infrared (IR) illuminators. When using a camcorder, use a fluid head unless panning to follow subject movement is not necessary.

Three-Way Head

Three-way heads, just as two-way heads, permit moving the camera vertically and horizontally (pan and tilt). Additionally, they permit rotating the camera assembly sideways 90-degrees to take portrait format pictures (vertical frame). These heads also permit photographing subject matter below the tripod (e.g., foot and tire impressions). Three-way heads are not as stable as two-way heads and they lack the weight-bearing capacity of two-way heads.

Ball Head

Some photographers like ball heads and some do not. The desirability of a ball head depends on the type of photography a person does, the photographic equipment they use, and their personal preference. In use, the camera and lens mount to a platform that sits on a ball. The rotational feature of the ball permits rapid movement of the camera on all axes of rotation.

From the perspective of manual clandestine photography, the detriments of a ball head include the following:

- A ball head is not as stable as a two-way head.
- A ball head cannot support as much weight as a two-way head.
- Ball heads feature a high profile in comparison to two- and three-way heads. The high profile can create balance problems when using heavy photographic equipment such as a high-magnification telephoto lens, and when photographing from within a motor vehicle.

Geared Head

Photographers and manufacturers refer to this class of head as a gear-head and geared head. Both terms are correct. Geared heads feature a gear system that permits making precise adjustments of whatever apparatus the head supports, usually a camera and lens assembly. All geared heads permit making precise tilt (vertical) adjustments and some permit making precise pan (horizontal) adjustments as well. A geared head is useful and sometimes essential for any type of photography using long- to ultra long-range optics (refer to Figures 5-17, 5-36, and 5-43 in Chapter 5).

Fluid Head and Fluid-Like Head

> Tripods and heads designed for still photography work poorly for video. Although the heads can be aimed anywhere, they cannot move smoothly enough for gentle tilts and pans. (Utz, n.d., n.p.)

Designed for videography, fluid heads permit smooth jerk-free pan and tilt camcorder movement (refer ahead to figures 3-4, 3-9, and 3-12). Although intended for use with video cameras, fluid heads work well with single-image cameras.

True fluid heads contain thick oil to dampen pan and tilt movement, the dampening of movement resulting in smooth action. The less expensive fluid-like heads contain grease to dampen movement. In most instances, both types of heads provide satisfactory service although overall, true fluid heads are more efficient and reliable. When used outdoors during cold weather, fluid-like heads become stiff and that limits their usefulness for manual clandestine videography.

Surveillance specialists working in climates featuring temperature extremes must consider the operational temperature range of the fluid or fluid-like head specified by the manufacturer. When used under conditions too hot or too cold, the head may not function properly. One fluid head on the market at the time of this writing features a functional temperature range of -10°C to 60°C (14°F to 140°F). Another fluid head, provided by a different manufacturer, features a functional temperature range -40°C to 60°C (-40°F to 140°F). Naturally, a specialist in Fairbanks, Alaska (USA), would select the latter, the fluid head rated for a low temperature of -40°C (-40°F). Conversely, a specialist in Cape Town, South Africa, would likely choose the fluid head rated for a low temperature of -10°C (14°F), everything being equal except price.

The point is that surveillance specialists must consider need when acquiring photographic equipment. They must select equipment according to what

they intend to photograph, the reason for photographing, and the conditions under which they will photograph. For the surveillance specialist, climatic conditions are always an important consideration.

Wimberley Head Version II

While most readers are likely very familiar with the different types of common tripod heads explained above, the Wimberley is a completely different design. Many readers are likely unfamiliar with this product. When the authors had the opportunity to test this head, they quickly realized the importance of introducing this product to the readers. This is the reason for the Wimberley section featuring product photos while the general descriptions of standard heads do not. The quality of genuine Wimberley Heads is phenomenal in terms of design, materials, manufacturing, assembly, and quality control procedures. Additionally, the level of Customer Service received form the manufacturer was excellent.

The Wimberley Head Version II features impressively smooth horizontal and vertical action because of mechanical superiority. Designed for action photography using short, medium, and super telephoto lenses, this head provides freedom of movement by supporting the weight of the camera and lens assembly at their balance point while permitting horizontal and vertical articulation around their center of gravity. This freedom of movement enables the surveillance specialist to follow moving subjects with ease (see Figure 3-2). When necessary, the specialist can lock the Wimberley Head in place so that the camera and lens are stationary (refer ahead to Figure 3-5).

Wimberley, Inc., in addition to the Wimberley Head Version II provides a range of high quality products featured on their website.[1]

VEHICLE WINDOW MOUNTS

Introduction

> When using a handheld camera or binocular from the driver's seat of a vehicle, detection by the subject is less likely when viewing through the open passenger side window as opposed to the open driver's side window.

Generally, with normal but unaided vision, from a distance of 229 meters (250 yards) a subject cannot discern that a vehicle occupant is directing a

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1. Wimberley, Inc., 974 Baker Lane, Winchester, Virginia 22603, USA. Telephone: 1.888.665.2746 (toll-free within USA & Canada). 1.540.665.2744 (outside the USA). Website: www.tripodhead.com.

Figure 3-2. The precision-engineered Wimberley Head Version II is ideally suited for the photographing of moving subjects. The Head permits the surveillance specialist to smoothly articulate the camera and lens assembly around their center of gravity to keep moving subjects properly framed. The smooth action of this precision head is impressive and with proper care, it will last an entire career.

handheld camera in their direction. From that distance, the subject can see that somebody is in the vehicle, but camera use is not apparent. Discerning camera use is even less likely when the camera is subdued, the lens sports an antireflection device (ARD), and the background against which the subject views the vehicle occupant is dark (refer ahead to Figure 3-31 and refer to Figures 6-27 and 6-28 in Chapter 6).

When using a camera and a spotting scope mounted side-by-side on window mounts, both should feature an ARD when observer to subject distance is limited (refer ahead to Figure 3-5). When mounting apparatus side-by-side and ARDs cover all lens surfaces, consider 274 meters (300 yards) to be a safe distance. That is, the distance that precludes a subject using normal but unaided vision discerning that the vehicle occupant is using optical equipment.

When using a binocular from the driver seat of a vehicle and observing out the open driver's window, from a distance of 197 meters (215 yards), a subject with normal but unaided vision cannot discern that the vehicle occupant is using a binocular. Discerning binocular use is even less likely when antireflection devices (ARDs) cover the objective lenses (refer ahead to Figure 3-27).

When determining the minimum distances from which camera and binocular use is detectable by a subject using normal but unaided vision, the authors used a Canon DSLR camera with a Canon 200mm f/2.8 telephoto lens and a 7x50 binocular. The camera, lens, and binocular were black, but neither sported ARDs for the experiment.

When photographing from the front seat of a vehicle from a distance sufficient to provide cover, window mounts are often useful. Unfortunately, most vehicle window mounts on the market support only lightweight apparatus such as a small digital camera, consumer grade camcorder, binocular, or spotting scope. Two heavy-duty window mounts worth considering are the Groofwin Pod (Ground-Roof-Window Pod) provided by Leonard Rue Enterprises, Inc. (www.rue.com), and the Kirk Multi-Purpose Window Mount provided by Kirk Enterprises (www.kirkphoto.com).

Window mounts serve a useful purpose, but they often result in a portion of the optical system extending outside the vehicle (see Figure 3-3). Circumstances determine if that is a problem. Nevertheless, an optical system extending outside the vehicle is more noticeable than when located fully within the vehicle. Additionally, extending outside the vehicle exposes the optical system to the elements (e.g., rain, sleet, snow, wind, sun, and airborne dirt). Finally, during temperature extremes, closing the window and using the vehicle heater or air conditioner during periods of subject inactivity is not as useful an option when using a window mount.

Kirk Multi-Purpose Window Mount

The Kirk Multi-Purpose Window Mount, machined from 6061-T6 aluminum and featuring stainless steel and brass hardware and black anodized finish, weighs only 1,360.78 grams (3 pounds). This high quality mount provides a stable platform when photographing from a vehicle is necessary with

Figure 3-3. Window mounts serve a useful purpose, but they often result in a portion of the optical system extending outside the vehicle. Here, the Kirk Multi-Purpose Window Mount supports the Canon EF 300mm f/2.8L IS USM telephoto lens. With the lens shade on the lens, it is more conspicuous to people outside the vehicle. When using window mounts with a telephoto lens, consider using an antireflection device (ARD) instead of a conventional lens shade. ARDs add little to the physical length of the lens and they result in the lens looking less like part of an optical system.

setup and takedown time being minimal (see Figure 3-4). This support system accepts conventional tripod heads, fluid heads, and the Wimberley Head Version II. The heads must feature a 3/8″-16 female thread.

Side-by-Side Window Mount Use

The surveillance specialist frequently finds it necessary to use a digital single-lens reflex camera in the mirror lock-up mode and use a remote release to operate the camera. With the camera mirror in the up position to prevent *mirror slap* induced vibrations when taking pictures, observing the subject through the camera viewfinder is not possible. Therefore, the specialist observes the subject through a spotting scope to select exposures. That procedure requires mounting the spotting scope beside the camera. When using this method from a vehicle with the camera supported by a window

Figure 3-4. The Kirk Multi-Purpose Window Mount is suitable for use with super telephoto lenses up to 800mm. Here the window mount supports a fluid head, which in turn supports the Canon XL2 Mini DV professional grade camcorder. For manual clandestine photography and videography, this window mount is the best the authors have found. Adding to stability is the clamp that grips the window glass.

mount, the specialist uses a second window mount to support the spotting scope (see Figure 3-5).

KIRK LOWPOD

In addition to being a fine window mount, the Kirk Multi-Purpose Window Mount serves well as a lowpod, also called a tabletop support (see Figure 3-6). Configured as a lowpod, it provides support for photographing from a tabletop, car roof, or any other suitable surface. For additional information about this product, visit the Kirk Enterprises website (www.kirkphoto.com).

Figure 3-5. Supported by the Kirk Multi-Purpose Window Mount, the Wimberley Head Version II in the locked position supports the Canon 300mm f/2.8L IS USM telephoto lens and Canon EOS 5D digital single-lens reflex camera. The 15-degree light-spread antireflection device (ARD) minimizes light reflection from the front element of the telephoto lens. This ARD on this lens is equivalent to a 48.3 centimeters (19 inch) lens shade yet it adds only 2.54 centimeters (1 inch) to the overall length of the lens. The authors made this ARD using polycarbonate plastic honeycomb grid material obtained from Honeygrids (www.honeycombgrids.com). The Leupold® Window Mount and ball head supports the Leupold Mark 4 12-40x60mm Tactical Spotting scope in the Soft Side Case.[2] The killFlash® Model #60LSC-ARD manufactured by Tenebraex Corporation minimizes light reflection from the front element of the spotting scope lens. The surveillance specialist is observing the subject through the spotting scope and using a remote release to operate the camera, which she placed in the mirror lock-up mode. Proper wrapping of the equipment with a Ghillie Rifle Wrap or long strip of black cloth will obscure the apparatus; somebody seeing it from a distance may wonder what it is, but the apparatus being a camera and spotting scope will be less apparent. Be creative!

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2. Leupold describes the 12-40x60mm Spotting Scope Soft Side Case as follows: "This form fitting, soft-side spotting scope case remains on the scope during use. . . . It easily opens to reveal the eyepiece, objective lens, and tripod mount. Velcro® holds the lens covers in place during use, so they won't obstruct your view. Deep brown, with the Leupold 'L' medallion" (Leupold & Stevens, Inc., 2009, n.p., *12-40x60mm spotting scope soft side case*). Leupold website: www.leupold.com.

Figure 3-6. The Kirk Multi-Purpose Window Mount serves also as a lowpod. Here, it supports the Wimberley Head Version II which in turn supports the Canon EOS 5D digital single-lens reflex (DSLR) camera fitted with the Canon EF 300mm f/2.8L IS USM telephoto lens. A Forest Green LensCoat™ covers the lens. The surveillance specialist working from, for example, a picnic table can place an antireflection device (ARD) on the lens and drape a dark colored jacket or sweater over the apparatus. As such, it will not appear to be a camera assembly, especially if situated between a picnic basket and 5- or 10-gallon beverage cooler. Be creative! A DSLR camera in HD video capture mode would permit recording superb video of the subject under the circumstance just described.

WOOD'S POWR-GRIP® VACUUM CUPS FOR CAMERA SUPPORTS

Wood's Powr-Grip Co., Inc. manufactures high quality industrial grade vacuum cups that people use for a variety of applications including mounting camera supports to a smooth nonporous surface, usually metal or glass.

Introduction

Wood's Powr-Grip Co., Inc. offers several camera supports featuring a vacuum cup that permits mounting a camera or other optical instrument to virtually any smooth nonporous surface such as metal or glass. Additionally, photographers have invented a variety of other camera supports featuring a Wood's Powr-Grip vacuum cup. As effective as vacuum cups are, and in spite of how easy they are to use, knowing how to use them properly is important.

Many people incorrectly believe that wetting the edge of a vacuum cup before applying it to a surface ensures a better seal. When asked about this practice, David Peters, Marketing Associate, Wood's Powr-Grip Co., Inc., offered the following advice.

> The practice of wetting the cup before applying it to a surface probably comes from the use of inexpensive little suction cups. When you apply a Wood's Powr-Grip vacuum cup to a surface, it is important to first clean and dry the surface. Likewise, make sure that the surface of the vacuum pad is clean, dry and free of debris. Do not wet the surface of the vacuum pad before applying it to the mounting surface. Water reduces the friction coefficient and reduces the vacuum pad's capacity and ability to stay attached to the surface. Wetting the pad before use also causes it to slip, especially on glass. The edge of the vacuum pad is the sealing edge for the entire pad, designed for this purpose. (David Peters, personal communication, August 11, 2010)

Wood's Powr-Grip Vacuum Cup Camera Supports

Wood's Powr-Grip Company offers a variety of vacuum cup camera mounts that surveillance specialists will find useful for in-vehicle use, and for other applications (see Figures 3-7 and 3-8). Locate photography vacuum cup products at the manufacturer's website by clicking on "Product Line" and then clicking on "Sporting Goods & Photography" (www.powrgrip.com).

In-House Fabricated Supports Using Wood's Powr-Grip Vacuum Cups

In addition to the vacuum cup camera mounts offered by Wood's Powr-Grip Company, individualized needs compel photographers and surveillance specialists to design other type of camera mounts featuring a Wood's Powr-Grip vacuum cup (see Figure 3-9).

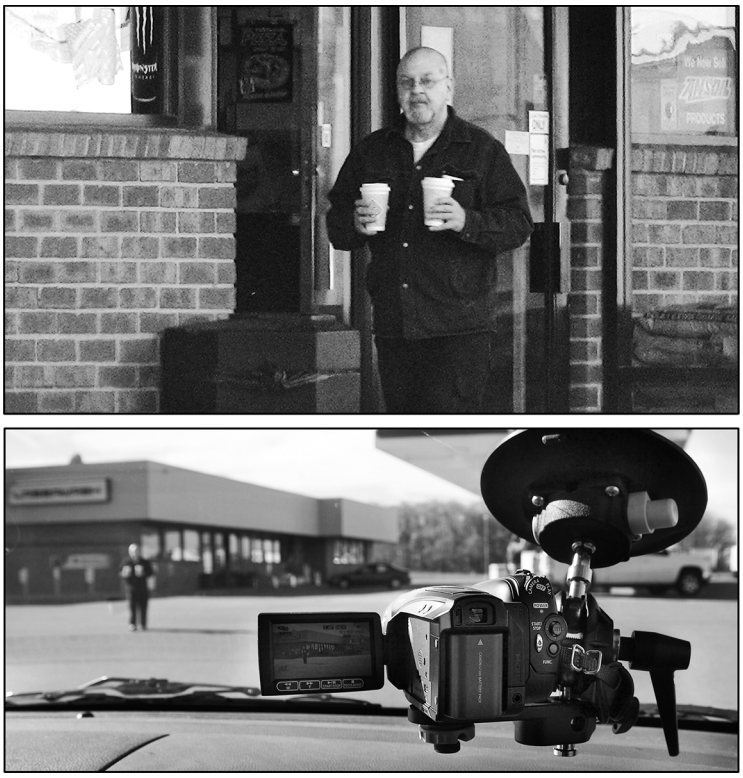

Figure 3-7. Wood's Powr-Grip Nukklehead (TL6PH155). The 6″ (15.24 cm) Concave Vacuum Cup with the Bogen Manfrotto® 155 Double Ball Joint Head with Camera Platform is supporting the Canon VIXIA HV30 high-definition camcorder. This camera support system features a maximum load capacity of 4.04 kilograms (8.9 pounds). This support works well for static surveillance (stakeout), for moving vehicle surveillance, and when driving through an area during reconnaissance. This support is also available with a 4 1/2″ (11.43 cm) concave vacuum cup, that mounting system called the 4 1/2″ Nukklehead Junior Vacuum Mounting Cup (LJ45PH155). When circumstances require, camouflage the camcorder so it appears to be something else. Sometimes, draping a dark colored cloth, jacket, or sweater over the camcorder is sufficient. Place an antireflection device (ARD) on the lens when necessary.

Vacu-Pod Model II

A useful product employing a Wood's Powr-Grip vacuum cup is the Vacu-Pod Model II invented and marketed by Michael Corlew of Avian-Wildlife Photography. Examine this product at his Vacu-Pod website (www .vacu-pod.com). The Vacu-Pod Model II positions the camera and telephoto lens fully within the vehicle (see Figure 3-10). This product works well with the Wimberley Head Version II and the Wimberley Sidekick™.

Figure 3-8. Wood's Powr-Grip 4 1/2″ (11.43 cm) Concave Vacuum Cup with Cleat Head (LJ45PHC) is supporting the Canon VIXIA HV30 high-definition camcorder sporting the 1.7x tele-extender lens. A section of aluminum flat stock mounted to the vacuum cup system permits positioning the camcorder the necessary distance from the window, this method being suitable only for static surveillance. Without the section of aluminum flat stock, this support system features a maximum load capacity of 4.54 kilograms (10 pounds).

The Wimberley Head Version II performs well in the inverted position even though not designed for overturned use. Although inverted, the Wimberley Head supports the weight of the camera and lens assembly at their balance point while permitting horizontal and vertical articulation around their center of gravity. The platform supporting the camera and lens is adjustable up/down 10.16 centimeters (4 inches) although raising the camera results in a top-heavy situation. For that reason, use a long Arca-Swiss mounting plate to achieve perfect balance and maintain a grip on the camera.

For vehicles lacking a sunroof, mount a piece of thick safety glass or some other nonporous material near the roof to support the Vacu-Pod. The non-

Figure 3-9. The author-invented triangular support bracket supports a fluid head and camcorder in both images. This support uses the Wood's Powr-Grip 4 1/2″ (11.43 cm) concave vacuum cup with threaded insert. *Upper image:* Support bracket mounted to the front door window of a passenger car. A monopod (actually 1970s era belt pod) sporting a small ball head supports the weight of the apparatus. The load capacity of the belt pod is unknown but it is limited. *Lower image:* Support bracket used in a minivan with blackout curtains omitted for purposes of this illustration. The Manfrotto 681B 3-section aluminum monopod supporting the bracket extends to the floor of the van. The monopod features a load capacity of 12 kilograms (26.46 pounds) and the Wood's Powr-Grip vacuum cup features a load capacity of 18.14 kilograms (40 pounds).

Figure 3-10. The 3 x 6 inch (7.6 x 15.2 centimeters) Wood's Powr-Grip vacuum cup supports the Vacu-Pod Model II from the sunroof glass. This apparatus positions the camera and lens fully within the vehicle, which protects them from the elements (e.g., rain, sleet, snow, wind, sun, and airborne dirt) and makes them less subject to detection by the subject. This product works well with the Wimberley Head Version II shown here and it works well with the Wimberley Sidekick. Suspending a black opaque cloth from a clothes hangar rod between the front and rear seat areas of the vehicle and applying see-through sunscreens to the windshield (windscreen) and opposite side window leaves the apparatus inconspicuous to people outside the vehicle (refer to Figure 6-23 in Chapter 6).

Figure 3-11. The Vacu-Pod Bar Camera Support system supports the Wimberley Head Version II, Canon EOS 5D digital single-lens reflex camera, and Canon EF 600mm f/4L IS USM telephoto lens. Illustrated here is a prototype that Michael Corlew, the inventor, loaned the authors for evaluation, feedback, and illustration in this book. More than one method exists for mounting this support system in a vehicle–think creatively. The monopod supporting the front portion of the Vacu-Pod Bar Camera Support in this illustration is not essential and neither does the manufacturer recommend it. The authors included the monopod for added support because of the weight of the optical system and because clandestine photography frequently occurs under low-light slow shutter speed conditions.

porous material can be a permanent installation or applied to the roof by means of a receiving bracket when needed.

Vacu-Pod Bar Camera Support

Wildlife photographer Michael Corlew, inventor of the previously discussed Vacu-Pod Model II, also invented the Vacu-Pod Bar Camera Support system, which at the time of writing is in the prototype stage (see Figure 3-11). Like the Vacu-Pod Model II, this apparatus brings photographic equipment fully within the vehicle. The 3 x 6 inch (7.6 x 15.2 centimeters) Wood's Powr-Grip vacuum cup secures the forward end of the rail to the vehicle windshield (windscreen).

Surveillance specialists doing photographic surveillance from within vehicles should consider the Vacu-Pod Bar Camera Support system, which probably will be available before publishing of this book is complete. When purchasing this product, select a second Arca-Swiss style quick-release clamp. When using a tripod to support the rear end of the bar use a quick-release clamp. Apply the second quick-release clamp to the bottom of the Wimberley Head; the grooves on the sides of the horizontal bar accept the quick-release clamp. After parking the vehicle in the desired position, the quick-release clamp permits rapidly mounting the Wimberley Head to the bar for use. The quick-release clamp also permits sliding the camera to any desired position along the length of the bar.

CUSTOM IN-VEHICLE SUPPORT SYSTEM

The author-invented In-Vehicle Support System is suitable for use in the front and rear seat area of passenger automobiles featuring bucket seats. This system positions the camera or camcorder over the console during use in the front seat area and midway between the doors when used in the rear seat area (see Figure 3-12).

Because a support system such as this is unavailable on the commercial market, in-house fabrication is necessary. Making this support system is not difficult for those with a bit of inventive ingenuity and metalworking skills, and appropriate tools (see Figure 3-13). If one lacks the means to fabricate this support system, contract with a steel fabricator to make it. The detriment of this support system is the inability to change seat position once installing the apparatus.

Figure 3-12. In a high countersurveillance environment, a passenger car is less likely than a van to become the subject of suspicious scrutiny. The author-invented In-Vehicle Support System, suitable for use in the front and rear seat area of passenger cars, serves best when used with see-through sunscreens and/or blackout curtains. Here, the support system supports two different model camcorders on two different fluid heads. *Upper image:* The surveillance specialist placed a see-through sunscreen over the windshield and applied black Sunvisor covers, black dash mat with a flap to cover the radio, and a black instrument panel cover. *Lower image:* Blackout curtains cover the rear and side windows, and a blackout curtain separates the front and rear seat areas. Velcro tabs enable the surveillance specialist to use a full or partial opening in the side-window curtains. Instead of opaque curtains, some specialists use black mesh cloth or solar window screen fabric that restricts people's view into the vehicle while permitting the specialist to see out. Velcro tabs and matt black gaffer tape works well to secure blackout curtains in place. Gaffer tape is available in various widths and colors, grips well in virtually all temperature situations, and it leaves no sticky residue when removed.

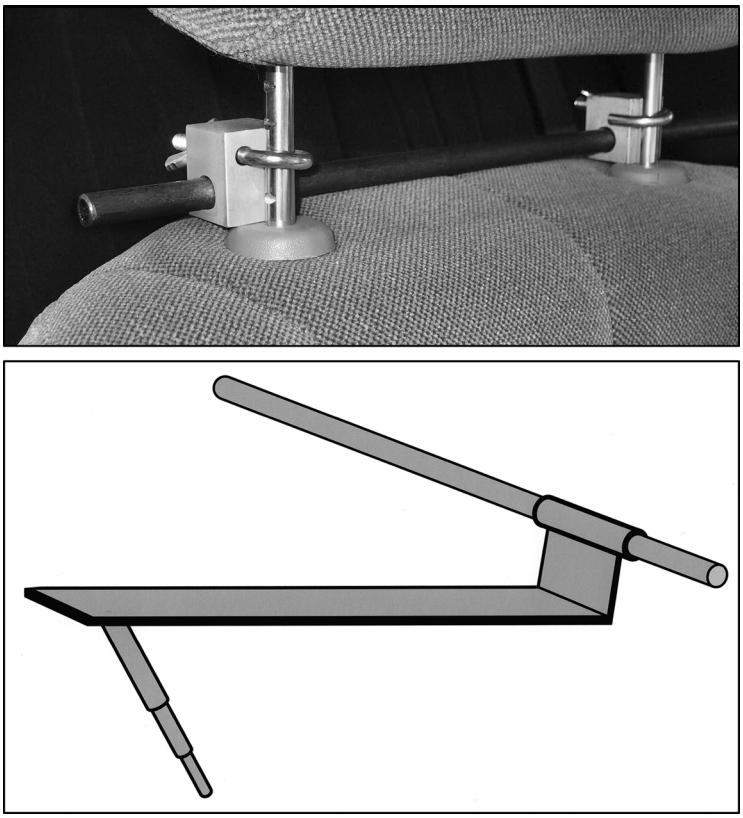

Figure 3-13. The In-Vehicle Support System is simple but effective. Most bucket seats feature headrests supported by vertical steel bars. The horizontal bar of the support system clamps to the vertical headrest support bars. A small ball head at the front of the support system accepts a short monopod. The monopod provides front-end support and permits making height/leveling adjustments.

LOW-PROFILE TRIPOD

To accommodate the confined space of sport utility vehicles (SUVs) and minivans, Brent Keepers, Director of Business Development, Morovision Night Vision, Inc. suggested to the authors the possibility of making a low-profile camera tripod reminiscent of the tripods that support machine gun pintle-mounts. The custom-made tripod illustrated here is the result of his suggestion and it works well (see Figure 3-14). This mount supports conventional tripod heads, fluid heads, and geared heads. The head illustrated here is a modified German equatorial mount salvaged from a tripod made for astronomical telescopes; the authors modified it for terrestrial use.

Figure 3-14. The custom-made low-profile tripod, in this case supporting a modified German equatorial mount, accommodates the confined space of sport utility vehicles (SUVs) and minivans. The remote release in the specialist's left hand permits operation of the camera without touching it. The Leupold Mark 4 12-40x60 Tactical Spotting Scope mounted parallel with the telescope serves as finder scope. It also enables the specialist to observe the subject while using the camera in the mirror lockup mode. The *Dual Scope Mounting Dovetail* featuring two saddles that accept two dovetail mounting plates permit positioning a spotting scope parallel with a telescope. The telescope and spotting scope move as an integrated unit. In the case of ultra long-range night vision photography, the Dual Scope Mounting Dovetail permits mounting an image intensifier night vision weapon sight parallel with a telescope to serve as a finder scope (refer to Figure 5-17 in Chapter 5). ScopeStuff® sells the mounting dovetail (www.scopestuff.com). The Celestron mini geared head supporting the spotting scope permits precise alignment of the two optical systems. *Camera:* Canon EOS 5D digital single-lens reflex camera. *Lens:* 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT). *Method:* Direct coupling (prime focus). In Chapter 4, discussion addresses the different types of telescope mounts (e.g., German Equatorial, altazimuth, and fork mounts). Regarding this illustration, during a live surveillance the specialist uses blackout curtains.

In the above illustration, the surveillance specialist is photographing through the open side door of a minivan. Photographing through vehicle windows works well when using a small diameter lens, but results are poor when using a large diameter lens such as the Schmidt-Cassegrain telescope (SCT) illustrated above (refer to Figure 6-38 in Chapter 6).

High-magnification photography from a vehicle often requires placing jacks under the vehicle at four points because even moderate winds cause

objectionable vehicle movement. When using stabilizing jacks, do what is necessary to prevent forgetfully attempting to drive away without first removing them.

ALTERNATIVE CAMERA SUPPORTS

Introduction

Generally, relative to camera stability, as stability increases mobility decreases. Conversely, as mobility increases stability decreases. Circumstances and needs determine how the surveillance specialist stabilizes photographic equipment during use.

With the exception of the author-invented Tree Mount Support that provides a platform "solid as a rock," tripods provide the best support for a camera and lens assembly. Unfortunately, tripods do not provide photographer mobility and not all situations permit using a tripod. When using a tripod is not practical, the surveillance specialist selects from a variety of alternative camera supports. Some supports are more efficient than others are with the appropriateness of each depending on circumstances (see Table 3-1).

This section presents a variety of camera supports appropriate for manual clandestine photography and videography using daytime optics and when adapted to an image intensifier night vision device (NVD). The sampling presented here is not exhaustive and presents only systems that the authors have used and know to be suitable for manual clandestine photography. Be alert for other support systems that may be appropriate–there are many.Videographers use support systems that photographers seldom use because of different needs. Some videography support systems are applicable for clandestine applications, but many are not because of their large size and the circumstances under which the surveillance specialist uses cameras and camcorders.

Monopod

In addition to providing stability for cameras and camcorders, monopods minimize operator fatigue.

The monopod, also called unipod, consists of a tripod-like head on a single telescoping leg to support and stabilize whatever apparatus the specialist uses it with, usually a single image camera or camcorder (see Figure 3-15). Although monopods cannot provide support comparable to a tripod, they

Table 3-1.

Comparison of Camera Support Systems									
	Handheld	Shoulder Mount	Body Mount Supporter	Monopod	Tripod	Vacu-Pod Model II	Vacu-Pod Bar Support	In-Vehicle Support System	Tree Mount Support
Comfortable	No (Tiring)	No (Tiring)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lightweight	N/A	Yes	Yes	Yes	No	N/A	N/A	N/A	N/A
Hands Free	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Rapid Mounting (Quick setup)	N/A	Yes	Yes	Yes	No	No	No	No	No
Pan/Tilt	Yes	Yes	Yes	Yes	Yes*	Yes	Yes*	Yes*	Yes*
Follow Action	Yes	Yes	Yes	Yes	Yes*	Yes	Yes*	Yes*	Yes*
Very Stable (Short time exposure possible)	No	No	No	No	Yes	Yes	Yes	Yes	Yes
*Can follow action and pan/tilt using an appropriate head (Fluid head–Wimberley Head Version II™–Wimberley Sidekick™)									

provide mobility and they minimize apparatus shake with random movements being smooth rather than erratic and jerky. Vertical and horizontal stability increases when bracing the monopod against a stationary object.

The monopod is lightweight and compact with the number of telescoping leg sections varying by model, three to five sections being typical. The greater the number of telescoping leg sections the lower the minimum height. Additionally, more leg sections result in less length when collapsed for storage and transport.

A monopod permits using a slower shutter speed, smaller lens aperture, lower ISO, a higher magnification telephoto lens, or a combination of these things. When used with a still camera or camcorder, the surveillance specialist may have the image stabilization feature turned on. Monopod stability and image stabilization working together permit effective photography

Figure 3-15. The monopod provides support for a single image camera, camcorder, binocular, spotting scope, laser range finder, or infrared (IR) illuminator. The monopod is useful also when photographing from within a vehicle. Here the monopod supports the Canon EOS 5D digital single-lens reflex camera fitted with the Canon EF 300mm f/4L IS USM telephoto lens. *Upper left image:* Monopod supported by the Manfrotto 080 belt pouch. When supported in this fashion, stability and mobility is good. *Upper right image:* The Manfrotto 361 Shoulder Brace enhances monopod stability.

under a lower level of illumination than is otherwise possible when hand-holding a camera.

When using a monopod in the standing position, they provide only fair mobility. Walking about with a monopod-mounted camera is awkward except when using it with a belt pouch as shown in the previous illustration, upper left image. When using a monopod without a belt pouch, collapsing it makes walking with the apparatus easier. Once at a newly chosen location, the specialist re-extends the monopod to the desired length.

Most monopods feature leg sections made of aluminum or carbon fiber. Some monopods feature more than one type of material. For example, a carbon fiber monopod may feature aluminum, magnesium, or titanium castings. The type of material affects weight and strength, strength, of course, affecting load capacity.

When selecting a monopod, realize that aluminum produces more sound during use than carbon fiber does, aluminum also producing a characteristic metallic sound. For clandestine operations, consider a carbon fiber monopod for the benefit of reduced weight, avoiding the metallic sound of aluminum, and in cold weather carbon fiber is easier on the hands than metal is.

Body Mount Supporter

When walking or waiting for activity to occur, the specialist can place the camera or camcorder in the down position, even closing a jacket over it for concealment and protection.

The Body Mount Supporter is a well-conceived, rugged, and easy to use camera platform the surveillance specialist wears. Accommodating all body sizes, it is functional and comfortable whether standing or sitting, or photographing from within a vehicle. Designed for sports photography, the Body Mount Supporter is ideally suited for many clandestine applications. The manufacturer offers male and female versions.

Yong Jia Lin invented the Body Mount Supporter and markets it under the business name CameraEQM.[3] In use the Body Mount Supporter comfortably accommodates camcorders and digital single-lens reflex cameras with a telephoto lens up to 400mm (see Figure 3-16).

When walking or waiting for activity to occur, the specialist can place the camera or camcorder in the down position, even closing a jacket over it for concealment and protection. When subject activity appears imminent, the specialist positions the camera or camcorder in the up position. In the up position, the specialist's hands remain free.

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3. CameraEQM. Website: www.eboboo.com. E-mail: Info@CameraEQM.com.

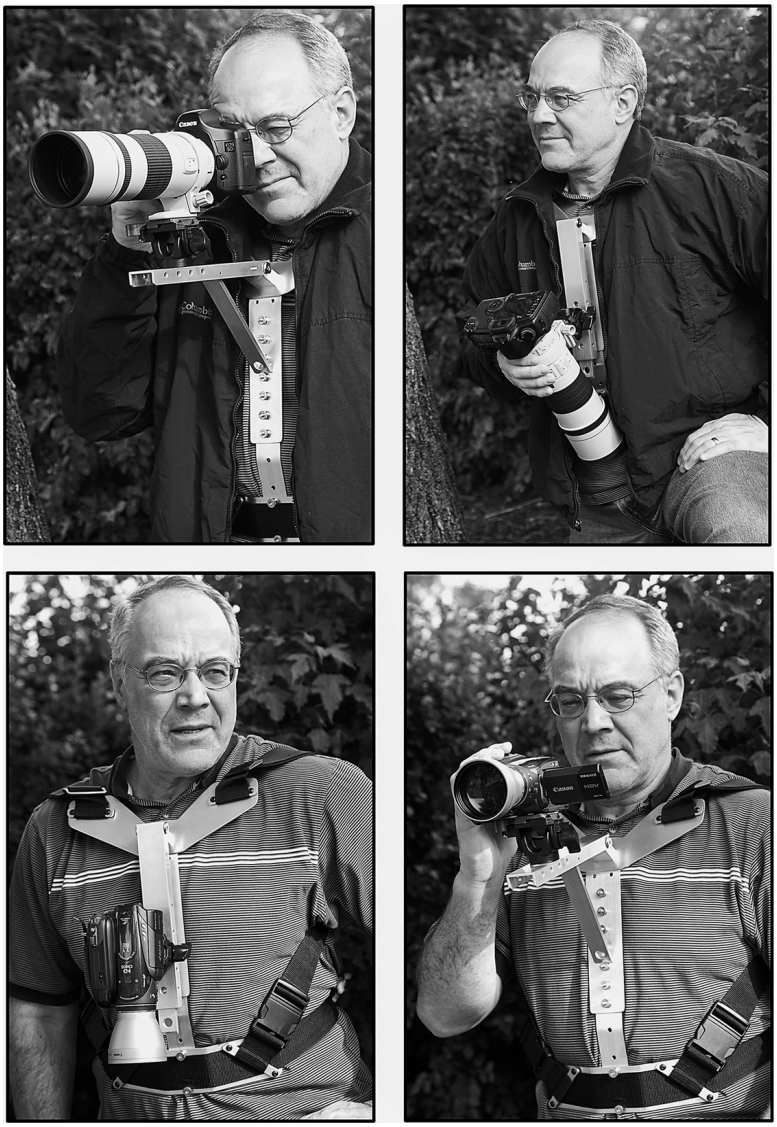

Figure 3-16. The Body Mount Supporter is a camera platform that the surveillance specialist wears. This apparatus provides camera stability and minimizes arm fatigue. *Upper images:* The specialist is using the Canon EOS 5D digital single-lens reflex camera and Canon EF 300mm f/4L IS USM telephoto lens. *Lower images:* The specialist is using the Canon VIXIA HV30 high-definition camcorder with the TL-H43 1.7x Tele-Converter lens.

The Body Mount Supporter features an unfinished aluminum surface. For clandestine use, if necessary, apply a coat of ultra-flat (low reflection) black or olive camouflage paint. An alternative to paint is low reflection black or camouflage tape. Gaffer tape is available in various widths and col-

ors, grips well in virtually all temperature situations, and it leaves no sticky residue when removed. Consider matt black tape. Another option is to have a black anodized finish applied.

BushHawk® Shoulder Mount

The BushHawk Shoulder Mount enhances stability when used with still cameras and camcorders with or without a gyrostabilizer.

The BushHawk shoulder mount provides camera stability in the standing, kneeling, and prone positions (see Figure 3-17). Moreover, the specialist will realize increased stability when resting the shoulder mount on a stationary surface or by using it with the foldable bipod assembly, monopod, or gyrostabilizer. The BushHawk illustrated here features the built-in two-position trigger for auto-focus and shutter release that accommodates Canon, Nikon, and other camera brands. The two-position trigger functions as a remote release. The two-position trigger is an optional accessory as is the Arca-Swiss style Quick Release Base and Plate.

When using the BushHawk Shoulder Mount, use a lens featuring no more focal length than necessary, and use a large aperture lens only when necessary. Weight increases as focal length and maximum aperture increases. This is an important consideration because the nature of the apparatus is such that it tends to be top heavy when used with high-magnification large aperture (fast) lenses.

To overcome the tendency of telephoto lenses to swivel on the shoulder mount, BushHawk offers the Arca-Swiss style Quick Release Base and Plate, a worthwhile optional accessory. The base attaches to the shoulder mount by means of two screws. The quick release base accepts a quick release plate attached to the lens tripod mount (foot) that is part of the rotation collar. One may purchase a quick release base or plate separately, or purchase them as a set.

BushHawk describes the quick release base and plate as follows: "New design incorporates all the features of Arca-Swiss with two positive stops. New 'captured' ergonomic knob. Attaches to the shoulder mount with two screws for added stability. Machined from tough aluminum alloy. Color: Black" (BushHawk, 2009, n.p., *Quick release*). Visit the manufacturers website to view the complete BushHawk product line (www.bushhawk.com).

Beanbag Support

Decide whether to purchase a commercial beanbag camera support or buy a bag of beans from the grocery store. Both work well to support small cameras and camcorders.

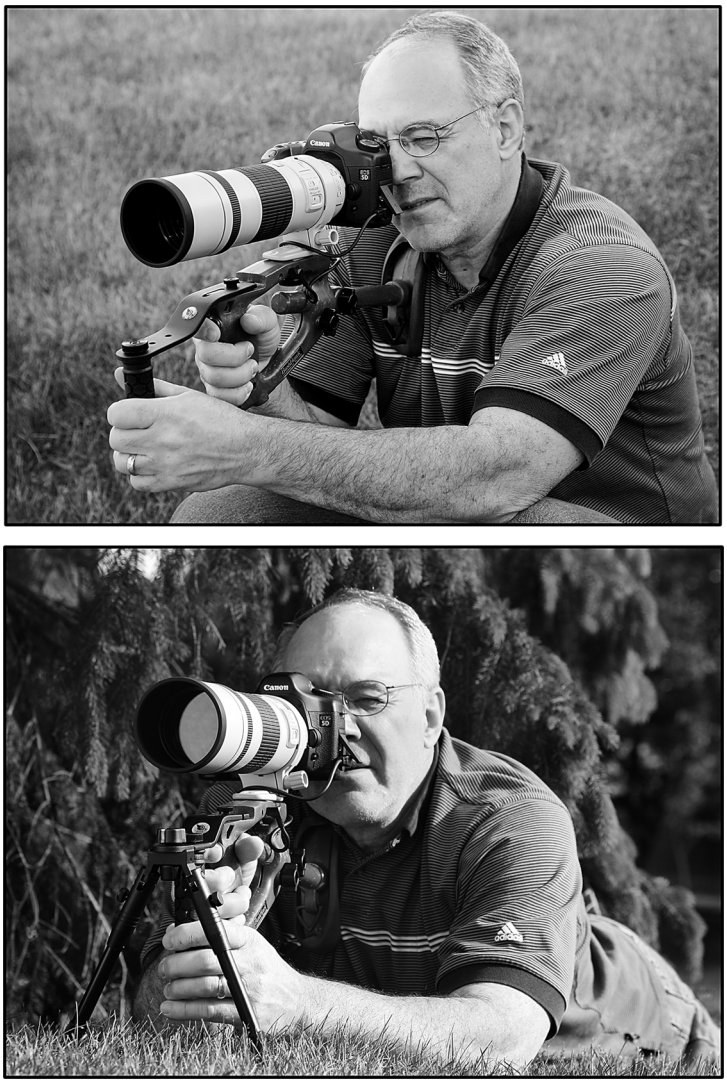

Figure 3-17. The BushHawk Shoulder Mount enhances stability of optical systems such as but not limited to digital single-lens reflex cameras, camcorders, and spotting scopes. *Upper image:* The surveillance specialist is using the BushHawk with the double handle and two-position trigger for auto-focus and shutter release control. He is photographing with the Canon EOS 5D digital single-lens reflex camera and Canon EF 300mm f/4L IS USM telephoto lens. *Lower image:* The specialist is using the BushHawk with the double handle two-position trigger and low profile foldable bipod assembly. Envision the lens, in this instance, featuring an antireflection device and Forest Green LensCoat™ cover. The BushHawk Shoulder Mount is appropriate also for some night vision photography applications (refer to Figures 5-31a and 5-42 in Chapter 5).

Figure 3-18. The OmniPod Pro-7 Beanbag provides a useful support for small digital cameras and camcorders. *Upper image:* The OmniPod features a 1/4-20 stud that permits securing it to any small camera or camcorder featuring the same size female thread. *Lower image:* The beanbag supports the Canon VIXIA HV30 high-definition camcorder on the door of an automobile; window rolled down. The camcorder sports the TL-H43 1.7x Tele-Converter lens. Observe the beanbag's slip resistant bottom. When filming from a vehicle, turn the engine off!

Many surveillance specialists consider beanbags a standard accessory item to provide support for a small digital camera or camcorder when spontaneous photography is necessary (see Figure 3-18). The OmniPod™ Beanbag camera and camcorder support, available in two sizes, is a quality product that permits steadying a small camera or camcorder on surfaces such as but not limited to:

- Vehicle door (window down)
- Vehicle dash
- Vehicle trunk (boot)
- Picnic table

- Vehicle roof
- Vehicle hood (bonnet)
- Tree limb
- Fence post or fence rail

Some surveillance specialists use grocery-store purchased beanbags as an alternative to the more expensive OmniPod (refer to Figure 6-25 in Chapter 6).

Tree Mount Support

Prephotography reconnaissance in rural areas will disclose the presence or absence of suitable trees upon which to attach the Tree Mount Support. This compact and lightweight support provides a platform considerably sturdier than the most robust tripod.

When traveling by foot to a remote rural site, minimize apparatus bulk and weight by taking no more equipment than necessary. High-magnification telephoto lenses and astronomical telescopes require a robust support but, unfortunately, heavy-duty tripods are large and heavy. Fortunately, the compact and lightweight author-invented Tree Mount Support is an excellent alternative to a heavy-duty tripod (see Figure 3-19). Figuratively speaking, it provides support that is as solid as a rock, support much steadier than a heavy-duty tripod can provide.

The surveillance specialist can mount the Tree Mount Support to a tree for use standing at ground level or position it high within a tree. Relative to the latter, camera elevation is sometimes necessary to photograph from above near-ground thermals and to achieve an unobstructed view of a distant subject location, or both. Locating the apparatus high in a tree also offers a clandestine value because most subjects do not expect a surveillance specialist to be perched in a tree.

When mounting the support system high within a tree, the specialist can work from a hang-on tree stand (deer stand) or fabricate a custom perch that is reminiscent of a hang-on tree stand. The problem with most tree stands is that their design positions the user facing away from the tree. When using a hang-on tree stand for photography with the Tree Mount Support the specialist needs to face towards the tree. The Summit 180 Max SS Climbing Tree Stand provided by Wing Supply in Greenville, Kentucky (USA) enables the user to sit facing the tree (www.wingsupply.com).

Ladder stands made for deer hunters typically feature a reach of 4.57–6.71 meters (15–22 feet). While those heights are suitable in many instances, greater height is sometimes necessary. An appropriate tree stand offers the means to work from almost any height a large tree provides.

When using a hang-on tree stand, climbing sticks or screw-in tree steps are usually necessary. Use only dull finish black or olive colored screw-in tree

Figure 3-19. The author-invented Tree Mount Support makes every appropriately located tree of suitable size a potential camera support. Using an endless ratchet strap the surveillance specialist secures the mount to a tree at any desired height above the ground. This mount is smaller and weighs less than a robust tripod, but it provides greater camera stability. Here the mount supports the Wimberley Head Version II, Canon EOS 5D digital single-lens reflex camera, and Canon EF 600mm f/4L IS USM telephoto lens with a 2x tele-converter. Extremely strong and steadier than a heavy-duty tripod, this support is suitable for use also with high-magnification Schmidt-Cassegrain telescopes (SCTs). Three small spikes, one on top and two on the bottom, bite into the tree resulting in extreme rigidity.

steps, preferably Vinyl coated for silence during transport and handling. Be sure to retrieve all steps at the conclusion of the operation.

When photographing from a remote site using high magnification, never use a robust tripod when circumstances permit using the smaller and lighter but much steadier Tree Mount Support. This accessory is not commercially available so in-house fabrication is necessary. Ideally, make the mount using aluminum and have it anodized.

Gyrostabilizers

> . . . the sounds characteristic of the outdoor urban and rural environment are sufficient to obscure the sound of a gyrostabilizer when used for clandestine photography.

> Two gyro wheels, one in each end of the device, stabilize against pitch and yaw motions, minimizing hand tremor and vehicular movement. (Kenyon Laboratories LLC, n.d., n.p., *Kenyon Gyrostabilizers Instruction Manual*)

The clandestine photographer often handholds a camera or camcorder under low-light conditions using a slow shutter speed. Additionally, the specialist often uses a handheld camera or camcorder while working from a moving platform. In either case, using a gyrostabilizer is often necessary. As the manufacturer explains, "When properly attached to a camera, the Stabilizer substantially extends the observer's range of discrimination. Objects may be clearly identified at a much greater range" (Kenyon Laboratories LLC, n.d., n.p., *Kenyon Gyrostabilizers Instruction Manual*).

A gyrostabilizer is also desirable when using a handheld camcorder from a stable platform under good lighting conditions because it contributes to a movement free view of the subject. Rather than hand tremor causing the image to jerk about the frame in a distracting manner, the subject slowly floats. Whatever the circumstances, a gyrostabilizer minimizes unwanted movement of a camera or camcorder (see Figures 3-20 to 3-22 and refer to Figures 5-15, 5-31a, and 5-42 in Chapter 5).

Once applying electrical power, the flywheels in a Kenyon gyrostabilizer reach maximum speed of about 21,000 RPM (rounds per minute) after approximately twelve minutes when using the standard inverter. The flywheels reach maximum speed in about half that time when using Kenyon's "Kwik start" inverters.

Gyrostabilizers will freewheel for approximately 20 minutes and provide good stabilization once removing electrical power. That feature provides the option of cycling the battery by unplugging the gyro and after about 10 minutes reintroducing electrical power. Repeating that process conserves battery power and thus extends use time beyond a single battery's normal use time. After use, a gyro flywheel can require up to one hour to stop spinning.

Kenyon Laboratories LLC manufactures high quality gyrostabilizers. They offer several models that make it possible to handhold optical systems weighing less than 0.907 kilograms (2 pounds) to as much as 5.443 kilograms (12 pounds). Naturally, the size and weight of gyrostabilizers varies by the stabilizing capacity of the unit.

Three considerations govern the selection of a gyrostabilizer. The three considerations are:

- The total weight of the optical system one will use with the gyrostabilizer.
- The capacity of the gyrostabilizer–capacity must be appropriate for the weight of the optical system applied to it.

Figure 3-20. The Kenyon KS-8 gyrostabilizer permits handholding a camera or camcorder with or without a night vision device under conditions that otherwise would require a support system such as a tripod. Battery pack and inverter not shown. Illustrated is the Canon VIXIA HV30 high-definition camcorder and ITT NEPVS-14 Night Enforcer® Gen 3 PINNACLE® night vision monocular with the Mil-Spec (military specifications) f/1.5 3x extension magnification lens. The platform supporting the camcorder and night vision device as an integrated unit is necessary, but at the time of this writing, in-house fabrication of the product is necessary. Nobody markets this essential accessory. When using only one gyrostabilizer with a camera or camcorder, "The Gyro must be positioned with the longitude axis of the lens–i.e. The Gyro must be in line lengthwise to the lens of the unit" (*Kenyon Laboratories LLC, n.d., n.p., Kenyon Gyrostabilizers Instruction Manual*).

- The intended application of the optical system requires consideration. When discussing gyrostabilizer needs with Randy Radzavich of Kenyon Laboratories relative to clandestine coastal photography from the Klepper Commando II 545 Military Folding Kayak, he explained that, "With calm waters I see no issues with using the KS-6 gyro kit. When encountering 'active' water you should consider the KS-8 kit. You should be happy with the KS-6 under general circumstances considering the weight of the device" (Randy Radzavich, personal communication, September 1, 2009).

The KS-6 gyrostabilizer weighs 1.47 kilograms (3.25 pounds). The KS-8 gyrostabilizer weighs 2.33 kilograms (5.13 pounds). Some surveillance specialists prefer to use the KS-8 for its greater payload and stabilizing capacity. When using a consumer grade camcorder, which weighs very little, consid-

Figure 3-21. The Kenyon KS-8 gyrostabilizer eases the task of holding a camera and telephoto lens steady when photographing from a moving platform. Here the surveillance specialist photographs from the Klepper Commando II 545 Military Folding Kayak. The specialist's left hand supports the Kenyon KS-8 gyrostabilizer, which in turn supports the Canon DSLR camera and Canon EF 300mm f/4L IS USM telephoto lens. The lens itself features image stabilization, which is active. The battery pack and inverter for the gyrostabilizer rests in the specialists lap and therefore they are not visible in this image.

er the Kenyon Explorer KS-2, which provides stabilization for an optical system weighing a maximum of 0.907 kilograms (2 pounds).

During handheld photography or videography, one gyrostabilizer in the horizontal position provides stabilization on two axes–pan and tilt. A second gyrostabilizer positioned vertically, perpendicular to the first, adds stabilization against roll and it doubles tilt stabilization. Using two gyrostabilizers in a horizontal "V" formation evenly balances the axes. For detailed information about the use of gyrostabilizers for photography and videography, consult the manufacturer, Kenyon Laboratories LLC. Kenyon sells and rents gyrostabilizers.[4]

Gyrostabilizers emit a low-volume high-pitched whine detectable only from a limited distance. A person can detect the distinctive sound of a digital single-lens reflex camera from much farther than they can detect the

4. Kenyon Laboratories LLC. 11 Scovil Rd., Higganum, Connecticut 06441 (USA). Telephone: 860.345.2097. Fax: 860.345.8652 / 800.253.4681. Website: www.ken-lab.com.

Figure 3-22. The Kenyon KS-8 gyrostabilizer permitted the surveillance specialist to handhold the digital single-lens reflex camera while recording this nighttime telephoto image using a 1/4-second shutter speed. Without the gyrostabilizer, the specialist was unable to record a usable photographic image while handholding the camera under the existing lighting conditions without using a higher ISO or under exposing to increase shutter speed. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 200mm f/2.8L II USM telephoto lens. *ISO:* 3200. *Aperture:* F/2.8. *Shutter speed:* 1/4-second. *Camera-to-subject distance:* 37 meters (41 yards). Regarding under exposure as a clandestine photography technique, refer to Chapter 4, subheading *Underexposure as a Low-Light Photography Technique.*

sound of a gyrostabilizer. The sound emitted by a gyrostabilizer creates no risk of detection during clandestine photography when used from typical standoff distances. Speaking to this issue, Randy Radzavich, Kenyon Laboratories LLC, manufacturer of Kenyon gyrostabilizers explained that, "The sound of a camera is sharp and singular whereas the sound of a gyro is constant. The gyros emit a sound that is between 30 and 40 decibels, unless it needs service for bearing noise. Additionally, constant sound is faded to the background by our minds naturally" (Randy Radzavich, personal communication, September 27, 2010).

How loud is 30–40 decibels? Compare that decibel level with the following decibel levels extracted from a variety of loudness comparison charts:

- Leaves rustling in the breeze–about 10 decibels (just audible).
- Purring cat–about 25 decibels (very quiet).
- Soft whisper–about 20–30 decibels (very quiet).
- Quiet rural area–about 30 decibels (very quiet).

- Wilderness–about 35 decibels.
- Rural residential–about 39 decibels.
- Agricultural cropland–about 44 decibels.
- Urban residential–about 59 decibels.
- Normal verbal conversation–about 60 decibels.
- Street noise–75–90 decibels.
- Canon AE-1 (35mm SLR film camera)–67–76 decibels. Varies by shutter speed.
- Nikon F2 (35mm SLR film camera)–76 decibels.

When contemplating the above decibel levels relative to the 30–40 decibels emitted by a gyrostabilizer, realize that the subject is a reasonable distance from the surveillance specialist. Because sound diminishes rapidly with distance, the likelihood of detection decreases as the specialist-to-subject distance increases. Relative to sound intensity diminishing with distance, the University of North Texas explains:

> The intensity of sound decreases with the *square* of the *inverse* of the distance from the source in an open area. . . . The intensity of sound (originating from a point source in an open environment) diminishes as the square of the inverse ratio of the distances from a source. . . . The Sound Intensity Level (SIL) decreases by 20 dB for every 10x increase in distance (University of North Texas, n.d., n.p., *Physics 1251*).

Because sound diminishes rapidly while traveling from the source to the subject, the surveillance specialist need not be far from a subject for a gyrostabilizer to go unheard. For example, from a distance of 15.24 meters (50 feet) the sound produced by a 40-decibel gyrostabilizer will have diminished to just 6.02 decibels, less than the sound of leaves rustling in the breeze. That being the case, it is evident that the sounds characteristic of the outdoor urban and rural environment are sufficient to obscure the sound of a gyrostabilizer when used for clandestine photography.

Ron Dexter, ASC, provides a website titled *Straight answers to frequent and seldom-asked film and video questions you will not find answered anywhere else.* The website offers a wealth of useful information for those interested in videography with the section titled *Gyroscopic Camera Stabilizations* being of particular interest (www.rondexter.com).

OTHER PHOTOGRAPHIC ESSENTIALS

Remote Controller: Wired and Wireless

When using a wireless remote controller to operate a camera or camcorder from a long distance, it is still "manual" photography. That is because the surveillance specialist visually observes the subject and remains in control of the camera. One example is drop vehicles, vehicles parked at the scene with the camera inside operated from a secondary location. Some surveillance specialists describe remote operation of a camera as unmanned but monitored photography.

A remote controller, electronic or mechanical, is necessary during extreme magnification photography and when using a slow shutter speed. Although this discussion pertains to digital single-lens reflex (DSLR) cameras, to varying degrees the information applies to other types of digital cameras and to camcorders. Photographers commonly refer to a remote controller as a remote release, remote shutter release, and a remote triggering device.

Traditionally, when taking a picture using a DSLR camera, the photographer depresses the camera's shutter button with his or her finger. Frequently, however, the surveillance specialist uses a wired remote controller while in close proximity to the camera or operates the camera from a greater distance using a wireless remote controller system. In each instance, the specialist visually observes the subject, is in control of the camera, and selects exposures. Therefore, the specialist is practicing "manual" clandestine photography irrespective of distance from the camera or the type of remote controller used.

Surveillance specialists use a remote controller for one of the following two reasons:

- A wired or wireless remote controller prevents image-degrading vibrations caused by touching the camera at the time of exposure. Often, the camera is in mirror lock-up mode.
- A wireless remote controller permits positioning a camera at one location, often concealed near the subject, and operating it from a distant secondary location.

A remote controller permits performing the following tasks without touching the DSLR camera:

- Activate the camera shutter.
- Operate the camera mirror-lockup function independent from activation of the shutter.

- Activate autofocus and auto exposure independent from activation of the shutter.

Clandestine photographers use a remote controller when photographing with high-magnification telephoto lenses and telescopes. A high-magnification optical system increases the effects of vibrations with amplification increasing as magnification increases. Recording blur free images requires preventing camera movement and vibrations at the time of exposure and that effort requires using a remote controller.

During night vision photography and during extreme magnification daytime photography, shutter speed often is slow and that requires operating the camera without touching it. What is extreme magnification photography? The Canon and Nikon 600mm f/4 super telephoto lenses with a 2x tele-converter provide 24x magnification. The surveillance specialist using daytime optics and night vision technology commonly photographs using magnification of 50x to 100x or more (refer to Figures 5-26 and 5-39 in Chapter 5).

A wired remote controller consists of a wire with a plug on one end and a controller transmit button on the opposite end. After plugging the remote controller into the camera's remote control socket, the surveillance specialist uses the controller transmit button as if it were the cameras shutter button. That permits operating the camera without touching it.

Most wired and wireless remote controllers feature a two-step system just as the DSLR camera's shutter button does. Pressing the transmit button halfway causes the auto-focus lens to set focus, and the camera calculates exposure. Then, fully depressing the transmit button activates the shutter to take the picture. The remote controller simply duplicates what the camera's shutter button does.

When using the mirror lock-up feature of a DSLR camera, the specialist depresses the remote controller transmit button one time and the mirror assumes the up position. The specialist then waits 1-3 seconds for vibrations to subside and then depresses the transmit button a second time to activate the shutter. After recording the image, the mirror returns to the down position. To record another image the specialist repeats the process.

A wireless remote controller system permits operating a camera from a distance, as stated. Wireless remote controller systems feature a receiver/trigger that plugs into the camera's remote control socket, and a sender/transmitter in the specialist's hand. The distance from which the specialist can operate a camera using a wireless remote controller varies by make and model.

Situations sometimes require concealing one or more cameras and operating them from a remote location by means of a wireless remote controller.

Concealing cameras in a rural area commonly requires camouflaging the equipment. Situations requiring a long-range remote controller include, but are not limited to, the following circumstances:

- Lack of a vantage point offering both concealment and an unobstructed view of the subject area requires setting up a concealed camera or camcorder and operating it from a distance.
- Lack of a vantage point that permits undetected travel to and from the location requires setting up a concealed camera or camcorder and operating it from a distance.
- Avoiding detection by an infrared thermal imaging device can require placing a camera where needed and then operating it from a location immune to detection by a thermal imaging device. The surveillance specialist may operate the camera from a nearby location where unrelated human presence is expected.
- Most radio remote controller systems feature multiple channels that permit the specialist to operate more than one camera, operating cameras selectively or as a group. That feature is useful when a situation requires concealing two or more cameras at disbursed locations to cover different areas of the subject location.

Wired remote controllers are passive–the subject cannot detect them. Some wireless controllers emit a radio frequency signal and some project an infrared (IR) beam. Wireless remote controllers that project an infrared (IR) beam are active when used at night. Being active means being detectable by somebody using an image intensifier night vision device (NVD) for counter-surveillance. Remote controllers that emit a radio frequency signal are detectable, but detection by the subject is less likely.

When a suitable vantage point is unavailable and therefore concealing one or more cameras or camcorders near the subject location for remote wireless operation is necessary, consider installing low-cost cameras and lenses. Do that to minimize loss in the event the subject discovers them. For example, conceal a low-cost model, an older model, or a discontinued but reliable model rather than an expensive new model.

Many wireless remote triggering systems exist, the features vary, and technology advances rapidly. For that reason, research the market before making a purchase.

Figure 3-23. This Canon EOS 5D digital single-lens reflex full-frame camera sports the Hoodman HoodLoupe 3.0 and the Canon Angle Finder C.

Hoodman HoodLoupe 3.0 and Viewfinder Magnifier

Hoodman HoodLoupe 3.0

The HoodLoupe 3.0 is useful when bright sunlight or reflections make seeing the camera LCD monitor difficult (see Figure 3-23). The HoodLoupe 3.0 accommodates camera LCD monitors up to 76.2 millimeters (3 inches) in size and provides an unmagnified view, 1:1 ratio. In use, the surveillance specialist places the HoodLoupe over the LCD monitor and examines the monitor through the eyepiece of the loupe. The HoodLoupe 3.0 features a +-3 diopter correction for focusing.

The specialist can place the HoodLoupe over the LCD monitor as needed or use the one size fits all Cinema Strap to secure the loupe semipermanently in place. The Cinema Strap is useful when using a DSLR camera in video capture mode or the Live View mode wherein the specialist frames the subject using the LCD monitor. For detailed information about the HoodLoupe, and to view other products the manufacturer offers, visit the manufacturer's website (www.hoodmanusa.com).

Viewfinder Magnifier

Prior to auto-focus lenses becoming the norm for single-lens reflex cameras, camera manufacturers offered straight-through optical viewfinder magnifiers. These accessories magnified the central area of the viewfinder image to facilitate accurate manual focus. Many models featured a hinge that permitted the photographer to flip magnifier up and out-of-the-way when viewing the entire frame area was necessary.

Photographers commonly used viewfinder magnifiers during close-up photography and during telephoto photography. Today, Nikon offers the DG-2 Eyepiece Magnifier featuring 2x magnification. Unfortunately, Canon offers no comparable product. Availability of straight-through viewfinder magnifiers from third-party (aftermarket) manufacturers is uncertain relative to performance and availability; the authors have been unable to obtain such a product for evaluation.

At the time of this writing, both Canon and Nikon offer right-angle finders, which magnify the central area of the viewfinder image. Unfortunately, although useful, they are not ideally suited for clandestine photography (refer back to Figure 3-23). Canon offers the Angle Finder C and Nikon offers the Rectangular Right Angle Finders DR-5 and DR-6. The Canon angle finder provides the choice of 1.25x and 2.5x viewfinder magnification. Nikon angle finders provide the choice of unmagnified (1:1) and 2x viewfinder magnification. Both Canon and Nikon angle finders feature built-in diopter correction.

Rectangular angle finders contain lens elements and a roof prism. The prism provides an erect image that is correct left to right but to a limited extent, the prism reduces the brightness of the viewfinder image. Diminished image brightness, even if slight, is a detriment during low-light clandestine photography. As for the 90-degree viewing angle, it is useful for waist-level, low-angle, and out of position photography. The 90-degree viewing angle is not ideal for clandestine telephoto photography in most instances because the surveillance specialist needs straight-through viewing.

Antireflection Device

> Being detected because of reflections has resulted in the loss of personnel, the failure of missions, and has even changed the course of battles. (camouflage.com, 2006, n.p., *Being Seen Can Mean Being Hit*)

Introduction

Placing an antireflection device (ARD) on a lens minimizes the likelihood that light reflecting from the lens will alert a subject to the surveillance.

Understanding this is important because failure to prevent light reflection can result in the lens acting like a signal mirror and betraying the photography team's presence and location. Light reflecting from a lens is detectable from a considerable distance as the following excerpt attests.

> In normal sunlight, the flash from a good signal mirror can easily be seen for 10 miles and generally the flash will be visible up to 50 miles, depending upon atmospheric conditions. . . . A mirror will even work on bright overcast days and with moonlight, though with much reduced range. (The Great Cardinal District Boy Scout Leader Roundtable, n.d., n.p., *How to Use a Signal Mirror.*)

Antireflection devices (ARDs) and the honeycomb grids for photography studio lighting fixtures have much in common. Each consists of honeycomb material that limits the angle of light passage. Studio photographers place honeycomb grids on lighting fixtures to control the spread of outgoing light (see Figure 3-24). Clandestine photographers use ARDs to control the angle at which light strikes and reflects from the front of a lens. Because ARDs and honeycomb grids each operate on the same principle, honeycomb grids perform well as an ARD when placed over the front of a telephoto lens or telescope.

The value of understanding the similarities between ARDs and honeycomb grids lies in the fact that large diameter ARDs are nonexistent, although surveillance specialists need them. Manufactured ARDs are only available for small diameter optics such as telescopic rifle sights, spotting scopes, and binoculars. Fortunately, honeycomb grids are plentiful and affordable and using them to make ARDs is easy. Additionally, honeycomb grids are available in a wide range of diameters and light-spread ratings. The two terms, light-spread and spread-of-light, are synonymous–they mean the same thing.

The honeycomb material of grids and antireflection devices (ARDs) consist of numerous small diameter tubes/cells (see Figure 3-25). The diameter of the tubes relative to their length determines the angle at which light passes through them. For studio lighting, honeycomb grids narrow the angle of light provided by a lighting fixture, which makes light control possible. When used as an antireflection device (ARD), the honeycomb grid material minimizes light reflection from lens surfaces by narrowing the angle of light passage.

The light-spread rating narrows as the diameter of the honeycomb cells diminish relative to their length, as stated. The smaller the diameter of each cell relative to length, the narrower the angle at which light passes through them. Stated another way, the density of the honeycomb determines the size

Figure 3-24. This studio lighting fixture accepts honeycomb grids that attach to the front of the reflector to control the angle of outgoing light. Photographers usually refer to honeycomb grids simply as grids with other terms including gridspot and light grid. This is a strobe lighting fixture consisting of a double bulb system featuring a flash tube and modeling lamp. The modeling lamp provides the continuous illumination necessary to achieve the desired lighting effect when moving the lighting fixture about. The flash tube is an instantaneous light that brightly illuminates the subject when taking a picture.

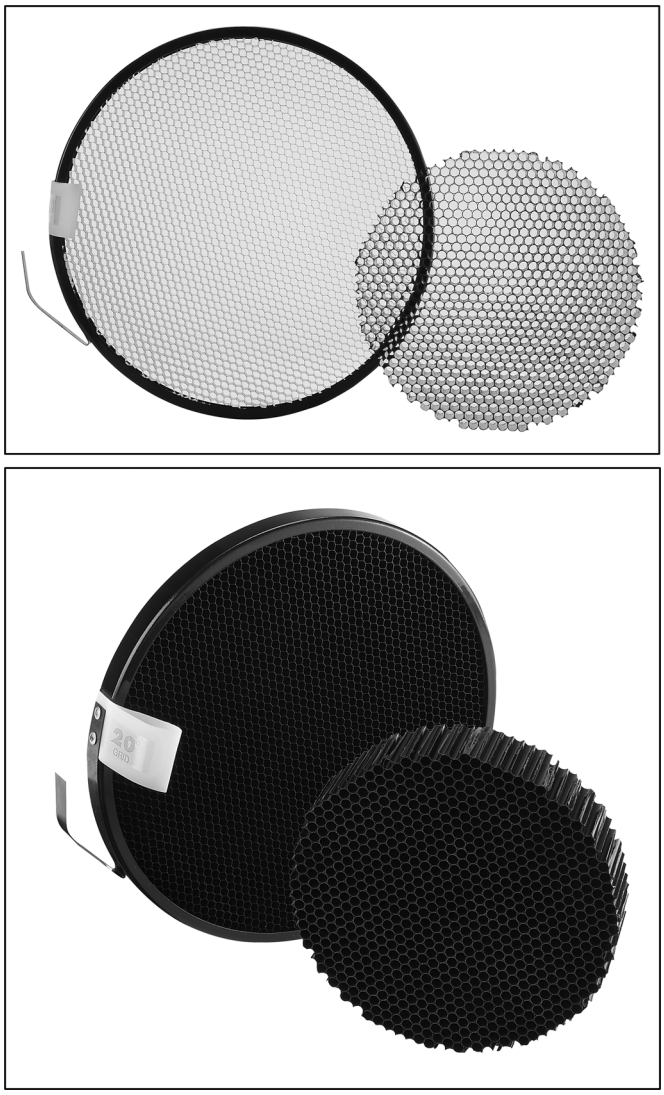

Figure 3-25. Honeycomb grids consist of numerous small diameter tubes/cells. The diameter of the tubes relative to their length determines the angle at which light passes through them. The upper and lower grids are the same, only the angle-of-view is different. The left grid features a 20-degree light-spread rating (beam spread rating) while the right grid features a 15-degree light-spread rating. When viewing honeycomb grids and ARDs they appear opaque or almost transparent depending on the angle from which one views them. The grid on the left is a 7-inch (177.8 millimeters) diameter circular grid manufactured by Speedotron Corporation. Speedotron sells grids of varying diameters and light-spread ratings. Honeygrids markets the polycarbonate plastic grid material on the right as a square, rectangle, or circle with the customer specifying desired dimensions. Cutting the polycarbonate honeycomb material to the desired size and shape is easy using a band saw or X-ACTO knife, this discussed shortly. Visit Honeygrids at www .honeycombgrids.com.

of the light circle the grid creates. Common light-spread ratings of circular honeycomb grids for photography studio lighting fixtures are 3-, 5-, 10-, 15-, 20-, 30-, 35-, and 40-degrees.

During clandestine photography, for best light reflection suppression and therefore best clandestine value use 3-, 5-, 10-, and 15-degree grids as an ARD. For best clandestine value, as closely as possible match the light-spread rating of the grid to the angle-of-view of the lens. When so doing, do not permit the angle-of-view of the lens to exceed the light-spread rating of the grid or image degradation will occur. That is important and discussed in detail shortly. In some instances, when minimum light reflection suppression is necessary, a 20-degree ARD is useful in lieu of a conventional lens shade to minimize the overall length of a telephoto lens or telescope.

Conventional Lens Shade Versus Antireflection Device

> Antireflection devices minimize light reflection from optical surfaces; they minimize the overall length of the lens; and they reduce the likelihood of wind driven rain, sleet, snow, and dirt reaching the front element of the lens. Additionally, the reduced length of the lens means less surface area, which leaves it less susceptible to wind induced movement. Finally, an ARD leaves the lens looking less like a lens.

Placing a conventional lens shade onto a telephoto lens or telescope helps to minimize light reflection from the front surface of the lens, but antireflection devices (ARDs) accomplish that more effectively. The narrow light-spread rating of the honeycomb material of the ARD prevents light reflection better than a lens shade does and it adds little weight and length to the lens (see Figure 3-26).

Manufacturers of telephoto lenses provide lens shades that are long enough to serve their intended purpose but not long enough to extend into the lens' field-of-view and cause vignetting. Lens shades add considerable length to a telephoto lens. Conversely, ARDs add little length to the lens while being equivalent to a very long lens shade (see Table 3-2).

ARD Applications

> Tenebraex Corporation makes small diameter antireflection devices using high impact low glare plastic.

Stated earlier, the optical systems most commonly associated with antireflection devices (ARDs) are telescopic rifle sights, spotting scopes, and binoculars (see Figures 3-27 and 3-28). When field conditions require using ARDs

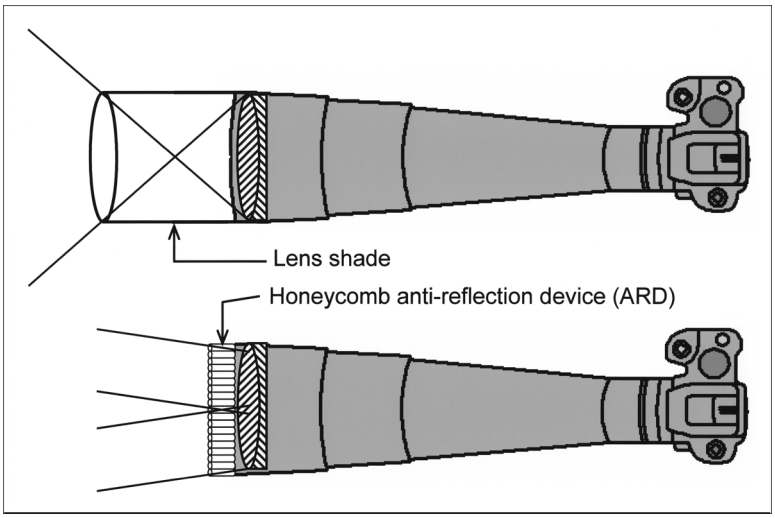

Figure 3-26. Antireflection devices (ARDs) consist of a honeycomb grid featuring numerous small diameter tubes (cells) that eliminate light reflections outside the ARD field-of-view and minimize light reflection within the ARD field-of-view. ARDs add little weight and length to the lens.

with such optical systems, using ARDs with photographic lenses is also necessary (see Figures 3-29 and 3-30).

Table 3-2.
ARD LIGHT-SPREAD RATING AND EQUIVALENT LENS SHADE LENGTH FOR THE CANON 300MM F/2.8 LENS

Light-Spread Rating	*Equivalent Lens Shade Length*
5º ARD	145 centimeters (57 inches)
10º ARD	72 centimeters (28 inches)
15º ARD	47 centimeters (19 inches)
20º ARD	35 centimeters (14 inches)
30º ARD	22 centimeters (9 inches)
40º ARD	15 centimeters (6 inches)
For best light reflection suppression and therefore best clandestine value, use 5-, 10-, and 15-degree grids. The 20-, 30-, and 40-degree grids provide limited benefit other than reducing overall apparatus length although that is important in some instances.	

Figure 3-27. The #6 SunGuard® anti-reflection devices (ARDs), manufactured by Tenebraex Corporation using high-impact low-glare polymer plastic, prevents light reflection from the objective lenses of this binocular. Because the manufacturer makes no ARDs that fit this binocular model, black nonreflective tape holds the ARDs in place. Consider using matt black gaffer tape. SunGuard diameters range from 36–59 millimeters (1.43–2.31 inches). The authors purchased this ARD set from MidwayUSA (www.midwayusa.com). Photograph by Miller Photography.

Figure 3-28. Leupold Mark 4 12-40x60mm Tactical Spotting Scope without and with the killFlash Model #60LSC-ARD antireflection device (ARD) made using high-impact low-glare plastic. Tenebraex Corporation manufactures this honeycomb ARD and MidwayUSA sells it. Tenebraex Corporation sells to civilians only through retailers. Photographs by Miller Photography.

Figure 3-29. The 15-degree antireflection device (ARD) on this Canon EF 300mm f/2.8L IS USM telephoto lens is equivalent to a 48.3 centimeters (19 inch) lens shade yet it adds only 2.54 centimeters (1 inch) to the overall length of the lens. The authors made this ARD using polycarbonate plastic honeycomb grid material obtained from Honeygrids (www.honeycombgrids.com). Cutting the plastic honeycomb material to size is easy using a band saw or X-ACTO knife. The surveillance specialist, photographing from a Jeep, is using the Wimberley Head Version II supported by the Kirk Multi-Purpose Window Mount.

In-House Fabrication of Antireflection Devices

Antireflection devices (ARDs) are essential in many instances. One of the authors was photographing at night from an upper floor of a high-rise hotel in Atlanta, Georgia (USA). A colleague viewing the vantage point from the vicinity of the subject reported that light reflection from the front element of the telephoto lens made it detectable. Placing an ARD on the lens made it undetectable. Making ARDs that screw to the filter threads of telephoto lenses is not difficult.

Antireflection devices (ARDs), stated earlier, are available for civilian and military optical systems such as telescopic rifle sights, spotting scopes, and binoculars. Unfortunately, nobody manufactures ARDs for camera lenses. Neither does anybody make ARDs with a diameter large enough for retrofit

Figure 3-30. The primary mirror of Schmidt-Cassegrain telescopes (SCTs) is large and highly reflective. The SCT shown here is the 3048mm f/10 12″ Meade LX90GPS. To minimize light reflecting from the mirror and alerting a subject to the surveillance, the surveillance specialist applied a 15-degree antireflection device (ARD) to the front of the lens tube. The authors made this ARD using polycarbonate plastic honeycomb grid material obtained from Honeygrids (www.honeycombgrids.com). Matt black gaffer tape holds the ARD in place. For best results, wrap tape around the front of the telescope tube and around the ARD, and then tape the two together. Gaffer tape works well in virtually all temperature situations and it leaves no sticky residue when removed. If desired, fabricate a metal bracket to hold the ARD in place. Paint the metal bracket flat black. Stacking two 15-degree grids results in a light-spread rating of 7.63 degrees. Stacking two 10-degree grids produces a 5-degree grid and stacking three 10-degree grids produces a 3-degree grid. When stacking honeycomb grids use alignment dowels to ensure perfect alignment before gluing the grids together. Stacking grids to reduce the light-spread rating is discussed shortly under the subheading *Stacking Grids to Reduce the Light-Spread Rating.*

use with high-magnification telephoto lenses and telescopes. Nevertheless, some situations require mounting an ARD to a camera lens or telescope.

With the exception of super telephoto lenses that accept drop-in filters, most telephoto lenses feature filter threads. Making ARDs that screw to the filter threads of telephoto lenses is easy and relatively inexpensive (see Figures 3-31 to 3-33).

When making an ARD, in preparation for cutting the honeycomb grid material use one of the rings as a template to mark a cutting line on masking tape applied to the grid material for that purpose. A band saw featuring a fine

Figure 3-31. Screwed to the filter threads of this Canon EF 70-300mm f/4-5.6 IS USM zoom lens is an in-house fabricated 15-degree antireflection device (ARD). On this lens, this ARD works only at partial and full zoom. The diagonal angle-of-view of this lens ranges from 34°–8° 15′. The angle-of-view of the lens must not exceed the 15-degree light-spread rating of this ARD or image degradation will occur. When necessary, as shown here, subdue the camera using a black permanent marker, black photo masking tape, or matt black gaffer tape. Gaffer tape grips well in virtually all temperature situations and it leaves no sticky residue when removed. Recently, photographing a subject using this camera and lens with and without the ARD, with the camera in automatic exposure mode, resulted in the same shutter speed and aperture in both instances, 1/350 second at f/6.7. ARDs cause little loss of incoming light!

tooth metal-cutting blade works well to cut the grid slightly oversize–feed the grid to the saw blade slowly! After cutting the grid using a band saw, finish it to size using a combination disc/belt sander. One can use an X-ACTO knife to cut the polycarbonate plastic honeycomb grid material sold by Honeygrids.

When in need of an exceptionally large diameter ARD, buy an oversize honeycomb grid featuring the desired light-spread rating, cut it to size, and attach it to the front of the lens (refer back to Figure 3-30). One can tape the grid to the lens or fabricate a bracket to hold it in place. To obtain conventional honeycomb grids, online go to B & H Foto & Electronics Corporation (www.bhphotovideo.com) and word search "grids for ac flashes" and try other word combinations if necessary. Also, visit the website of Honeygrids

Figure 3-32. These are the components of the antireflection device (ARD) on the camera in the previous illustration. *Lower left image:* Filter ring salvaged by removing the glass from a camera filter. *Upper left image:* Honeycomb grid material cut to the appropriate diameter. *Upper right image:* Flanged cylinder machined in-house. *Lower right image:* Assembled ARD. An alternative to salvaging the filter ring from a filter is to purchase an Empty Camera Filter Ring or a step-up adapter ring from CameraFilters.com™ (www .camerafilters.com). CameraFilters.com and CameraGear.com™ (www.camera gear.com) are the same company. Use appropriate glue when assembling the components, this ARD assembled using Gorilla Super Glue.

(www.honeycombgrids.com) who provides polycarbonate plastic honeycomb grid material featuring a 15-degree light-spread rating. At the manufacturer's website, click on "DIY–Grid Panels" to view their line of honeycomb grid products. The supplier will custom cut squares, rectangles, and circles to customer specified dimensions although some surveillance specialists prefer to size the material themselves using one of the methods described in the previous paragraph.

Match the Honeycomb Grid to the Lens

Lenses feature an "angle-of-view" rating. Honeycomb grids and ARDs feature a "light-spread" rating. Think of angle-of-view and light-spread as being the same. When selecting a honeycomb grid to use as an ARD, ensure that the angle-of-view of the lens never exceeds the light-spread rating of the grid.

Figure 3-33. Another method for making an ARD requires two step-up adapter rings or two filter rings. Here, the honeycomb grid material is sandwiched between two step-up adapter rings with Gorilla Super Glue holding the components in place. If desired, for better results, use a lathe to remove the threaded portion and enlarge the opening of the forward step-up ring (left image). Should a lathe be unavailable, modify the step-up ring using a die grinder or mini grinder fitted with a small sanding drum. Having modified the ring, apply flat black paint to the freshly machined metal. Apply a strip of matt black gaffer tape to the perimeter of the ARD between the two rings as was done with the left ARD. For illustration purposes, the perimeter of the ARD on the right features no tape.

The performance of a lens when used with an anti-reflection device (ARD) is an issue of lens angle-of-view relative to the ARD light-spread rating. When the angle-of-view of the lens is equal to or less than the light-spread rating of the ARD, image quality is good. When the lens features an angle-of-view greater than the light-spread rating of the ARD, image quality suffers.

The Canon and Nikon 600mm f/4 telephoto lenses feature a diagonal angle-of-view of 4° 10′, which is a narrower view than the light-spread rating of a 5° grid. Therefore, a 5° grid works well when used as an ARD with a 600mm or greater focal length lens-the ARD does not choke-down the image. When using a 3° light-spread rating ARD with a 600mm telephoto lens, using the lens with a 2x tele-converter is necessary to reduce the angle-of-view of the lens.

Stacking Grids to Reduce the Light-Spread Rating

Circumstances sometimes require a high-magnification large-diameter lens such as a Schmidt-Cassegrain telescope (SCT) and an ARD featuring a narrow light-spread rating. The problem is, large-diameter grids feature a

comparatively broad light-spread rating. For example, the narrowest light-spread rating of a 29.21 centimeters (11.5 inches) diameter Speedotron grid is 10-degrees. The narrowest light-spread rating of a 40.64 centimeters (16 inches) diameter Speedotron grid is 20-degrees. Hensel provides a 10-degree grid with a diameter measuring 30.48 centimeters (12 inches).

When a lens requires a large diameter ARD, but circumstances require a narrower light-spread rating than grids of the appropriate diameter provide, stack two or more grids one on top of the other. When stacking grids use alignment dowels to ensure perfect alignment of the honeycomb tubes and then glue the grids in place. Double and triple stacking grids will reduce the light-spread rating.

Stacking two 10° grids results in a 5° grid.
Stacking three 10° grids results in a 3° grid.
Stacking two 15° grids results in a 7.63° grid.
Stacking two 20° grids results in a 10° grid.
Stacking three 20° grids results in a 7° grid.
Stacking four 20° grids results in a 5° grid.

The above light-spread ratings are close approximations and adequate for the surveillance specialist when stacking grids. Mathematician and physicist Roger Siljander (personal communication, February 10, 2010), offers the following mathematical explanation regarding the effect that stacking grids has on the light-spread rating. He explains:

> The relationship is defined by the trigonometric tangent function. . . . The relationship is not linear. . . . In physics, we sometimes use what we call a small angle approximation when we are not concerned about exacting precision. For small angles, the tangent function is approximately linear. So, for small angles, say 10 degrees or less, you can approximate the effect by saying that doubling the length of the grid tubes will cut the angle in half, but you would be in error by 0.03 degrees. . . . In regards to your spreader question, if you stack two 20-degree grids on top of each other you have essentially doubled the length of the tubes. Using the small angle approximation, you would say that you have effectively halved the angle to 10 degrees. The exact answer is 10.31 degrees.

When ARD Use Is Necessary

Antireflection devices (ARDs) are frequently essential when using optical systems from a remote site in rural areas. Conversely, the nature of the urban environment often leaves ARD use unnecessary, especially when pho-

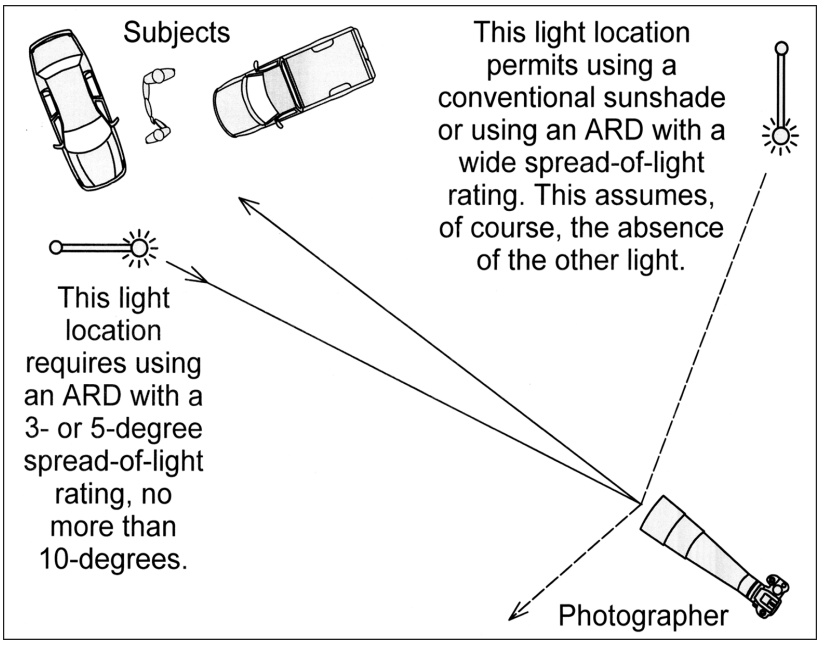

Figure 3-34. The nature of the environment and the location of light sources relative to the subject and camera locations determines if using an ARD is necessary and, if so, the required light-spread rating.

tographing through a door or window opening from within a darkened room. Indeed, the urban environment is visually noisy and that tends to provide good cover against detection. Such things as the following characterize the urban environment:

- Dense human population.
- Perpetual human activity and therefore motion.
- Varied shapes of different sizes.
- Colors of varied shades and brightness.
- Reflective and dull surfaces.
- Frequent light reflections.

The location of light sources relative to the subject and camera locations determines the likelihood of light reflecting from an unprotected lens surface revealing the presence of the photography team. Light source direction determines if using ARDs in place of a traditional lens shade is necessary and, if so, the required light-spread rating of the ARD (see Figure 3-34). Whether the light source is the sun, moon, or manmade is irrelevant.

ARDs and Image Quality

> Antireflection devices cause slight image quality deterioration and nominal reduction of light passage when used for photography during the day and at night. Certainly, slight softening of the image is preferable to discovery by the subject of surveillance. In many instances, the reduction of light transmission is so limited that it causes no aperture and shutter speed change.

Many readers no doubt wonder to what extent antireflection devices (ARDs) degrade image quality and reduce the passage of light. The question is legitimate because image quality does diminish somewhat and the level of incoming light does decrease. Nevertheless, deterioration of image quality is minimal and the reduction of light transmission is so limited that it often causes no aperture and shutter speed change. The above is true as long as the angle-of-view of the lens is no greater than the light-spread rating of the ARD. ARDs somewhat soften but do not destroy image quality (see Figure 3-35).

In many instances, antireflection devices (ARDs) are as necessary at night as they are during daylight hours. That raises the question whether quality images result when using an ARD during high ISO available light photography at night. Because ARDs only soften the image, and because they cause minimal reduction of light passage, they perform well under low-light conditions. That is, as long as the angle-of-view of the lens does not exceed the light-spread rating of the ARD (see Figure 3-36a). In some instances, artificial light sources located in the field-of-view present a challenge although that is a situation independent of the ARD on the camera lens (see Figure 3-36b).

Combination Lens Shade and Antireflection Device

Using metal one can make a combination lens shade and antireflection device (ARD) for telephoto lenses (see Figure 3-37). When designing such a product, realize that the lens shade for dedicated telephoto lenses often match the angle-of-view of the lens; extending the length of the lens shade can cause vignetting. Therefore, significant lens shade extensions perform best when using a tele-converter with the lens to decrease angle-of-view.

Circular Polarizing Filter

Using a digital still camera or camcorder, clandestine photographers sometimes photograph subjects through glass. Occasionally, from outside, it is necessary to photograph subjects in a building or sitting in a vehicle. Re-

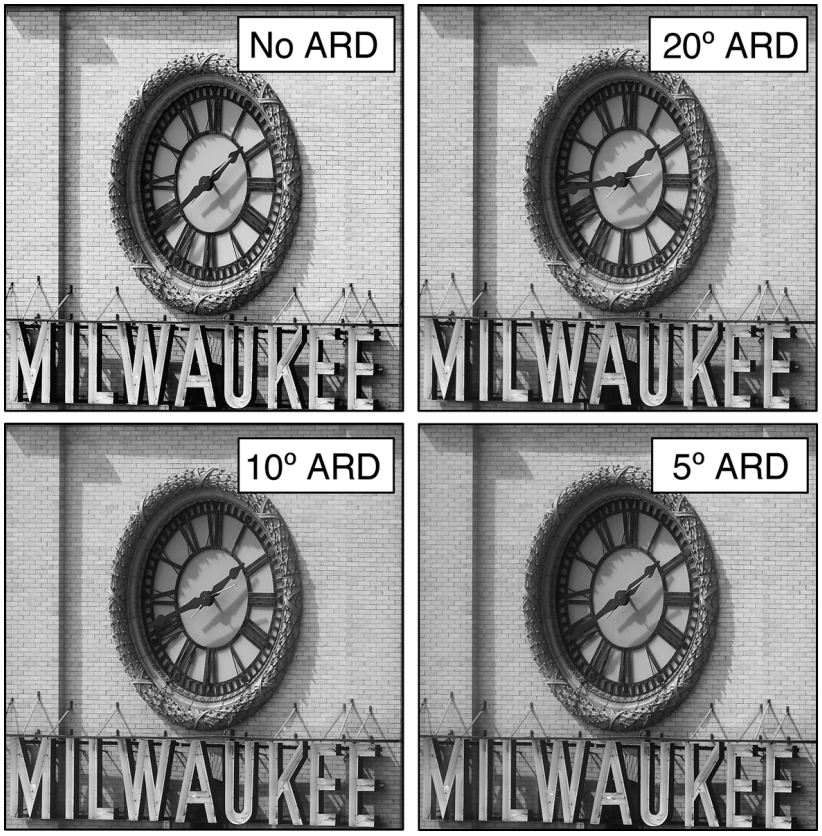

Figure 3-35. Antireflection devices (ARDs) soften an image, but they do not destroy it and while some loss of light occurs, light loss is minimal. The surveillance specialist recorded each image during daylight hours using ISO 100, aperture f/9, and shutter speed 1/125 second. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 600mm f/4L IS USM super telephoto lens.

flections on the glass often prevent recording quality photographic images of subjects located on the opposite side of the glass unless using a circular polarizer filter (see Figure 3-38).

Rotating circular polarizing filters remove glare from nonmetallic surfaces such as glass. Although polarizing filters are often essential, they reduce light transmission by 1.5-2 stops irrespective of the rotational orientation of the filter relative to the lens. Polarizing filters range in size from 25 to 127 millimeters (0.98 to 5 inches), large-diameter filters being expensive. Commonly, filters screw to the front of camera lenses although Canon and Nikon super telephoto lenses accept 52mm drop-in filters featuring a gear driven filter rotation mechanism.

Figure 3-36a. Antireflection devices perform well during daylight hours and at night, which is fortunate because ARDs are necessary during the day and at night. The surveillance specialist recorded these nighttime images from a distance of 155.45 meters (170 yards) using a digital single-lens reflex (DSLR) crop-sensor camera set at ISO 3200. The diagonal angle-of-view of the Canon EF 70-300mm f/4-5.6 IS USM zoom lens used to record these images ranges from 34°–8° 15′ (refer back to Figure 3-31 to view the camera, lens, and ARD used to record these images). When using a honeycomb antireflection device (ARD), a 15-degree ARD in this instance, the angle-of-view of the camera lens must not exceed the light-spread rating of the ARD or image degradation results. *Upper image:* Image recorded at full zoom, 300 millimeters. At full zoom, the angle-of-view of the lens is less than the ARD light-spread of 15-degrees. Image quality is good. *Lower image:* Image recorded at partial zoom, 135 millimeters, which resulted in the angle-of-view of the lens exceeding the ARD light-spread rating of 15-degrees. Image quality is poor–image sharpness is lacking. Flare from the security light further degrades image quality, flare existing in both images, although not caused by the ARD.

Figure 3-36b. This nighttime image recorded through a 15-degree antireflection device (ARD) is essentially the same as the upper image in the previous illustration with the exception that a tree is located between the camera and the security light. The result is elimination of lens flare. The surveillance specialist accomplished this by moving the vehicle forward about 3.05 meters (10 feet). When recording this image and those in the previous illustration the surveillance specialist was photographing from within his vehicle with the camera on a fluid head supported by the Kirk Multi-Purpose Window Mount.

Laptop Tripod Mount

Clandestine photographers sometimes photograph directly to a laptop computer. When so doing, mounting the computer to a tripod often is convenient and efficient (see Figure 3-39).

Photographing directly to a laptop computer provides two benefits. First, the computer features high-capacity image storage. Second, viewing a large image on the computer screen is more efficient than viewing a small image on the camera LCD monitor. For example, a focus discrepancy that escapes notice when viewing an image on the camera LCD monitor becomes apparent when viewing the same image on a computer screen. Additionally, ascertaining the existence of essential detail often requires viewing an enlarged image. Essential detail includes, but is not limited to, subject facial recognition and decipherable vehicle number plates (license plates).

Figure 3-37. This author-invented lens shade extension features baffles that further reduce the angle at which incoming light can reach the front lens element. The somewhat irregular front edge adds camouflage value for rural use. This lens shade extension fits the Canon EF 300mm f/2.8L IS USM telephoto lens and requires using a 2x tele-converter to prevent vignetting of the image. Tele-converters reduce the lens's angle-of-view. Ultra-flat black paint covers interior surfaces of this ARD. Unlike honeycomb ARDs that minimize the overall length and weight of the lens, this product adds considerable length and weight, a factor one must consider–construct it using aluminum which is lightweight. When extreme covertness is necessary, consider using a product such as this with a honeycomb ARD. A secondary benefit of this product is the series of small holes on the underside permitting rainwater to drain before reaching the lens. The Wimberley Head Version II supports this camera and lens.

Laser Rangefinder

Laser rangefinders are useful to determine camera-to-subject distance. A laser rangefinder transmits a laser pulse and then computes distanced based on the time required for the laser pulse to travel to and reflect from the target. Before making a purchase, research the topic and select a product most

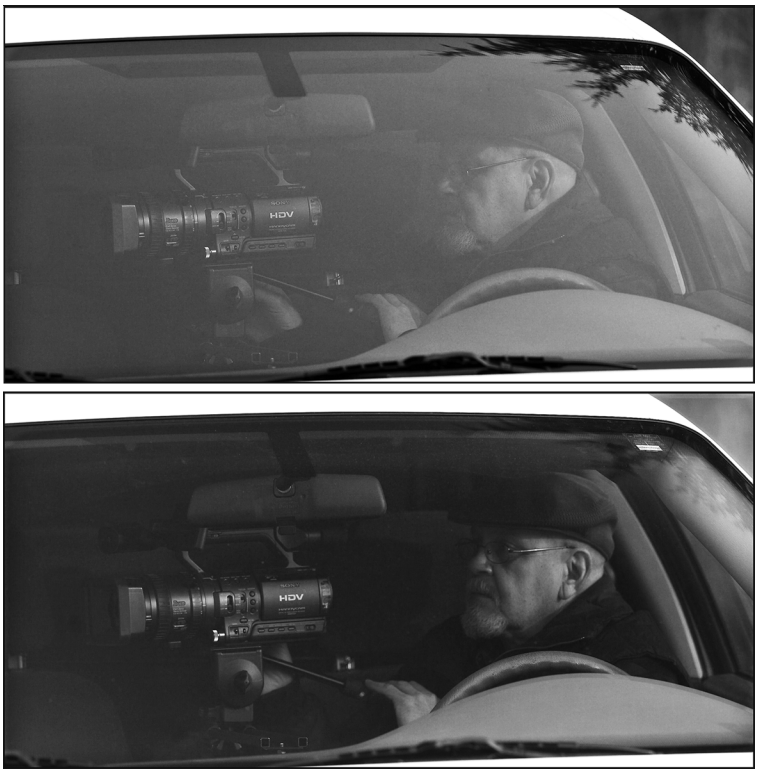

Figure 3-38. Circular polarizer filters remove glare from glass. Whether subjects are in a vehicle or inside a building, photographing them through glass often requires using a polarizer filter. *Upper image:* The photographer used no polarizer filter. *Lower image:* The photographer used a polarizer filter. In this illustration, the In-Vehicle Support System supports the Sony camcorder.

suitable for the intended application. Usually, those working in the rural environment need a rangefinder featuring greater range than those working in urban environments. Realize that the maximum range of a laser rangefinder, as reported by the manufacturer, is the range of the unit under ideal conditions. In the field, most laser rangefinders do not work from the maximum stated distance. Consider this when selecting a rangefinder.

NAVSTAR Global Positioning System (GPS)

The GPS is a space-based, global, all-weather, continuously available radio positioning navigation system. It is highly accurate in determining position location derived from a satellite constellation system. It can determine the

Figure 3-39. Surveillance specialists commonly photograph directly to a laptop computer hard drive. The authors began with the LTMH-Laptop on Tripod Mount Holder invented and market by Yong Jia Lin, CameraEQM.com, and modified it to make it clandestine photography specific. The model featured here is unfinished aluminum. The manufacturer advises that in the future this product will feature electrostatic powder coating finish. View this product as the manufacturer sells it by visiting his website (www .eboboo.com). *Important note:* The manufacturer frequently photographs events wherein many children are present and he worries about a child walking into the eye level horizontal bars that the authors added to support a laptop computer. For the sake of child safety, the commercial model features no such bars.

latitude, longitude and elevation of the individual user. (FM 3-97.61, 2002, August 26, n.p., *Military Mountaineering*)

Handheld GPS Receiver

When the reconnaissance team locates the best rural vantage point for photography, they mark the location on a map and they use a handheld GPS receiver to identify the coordinates of the location. Designating the subject location in a like manner is desirable. Moreover, when the reconnaissance team identifies the best primary and alternate routes to and from a rural vantage point, they identify the routes on a map and include GPS coordinates.

GPS technology is remarkable but not without shortcomings. Never rely on GPS technology for rural navigation to the exclusion of a map, compass, and navigation skills. When maps and handheld GPS receivers contain location and route information, security against loss, theft, and capture is important.

Vehicle GPS Navigation Device

A Vehicle GPS Navigation Device eases the task of driving to locations in unfamiliar territory by providing audible (voice) turn-by-turn directions to a destination. Most devices provide location and speed while driving, location accuracy being within a few yards (a few meters). Some devices permit trip planning wherein the operator can enter multiple stops in addition to the final destination.

Darin Fredrickson, CPP, 19-year Police Detective and President of Team Guardian, LLC, Investigation and Security Specialists, commented on his use of GPS navigation technology during physical surveillance. He explained that, "Screen size helps me in my job, but most consumers it seems prefer accurate voice directions. I use it during surveillance to identify streets that dead end, cut through, side-by-side, etc. It helps when a burglar hits a neighborhood" (Darin Fredrickson, personal communication, July 14, 2010).

When comparing GPS products in anticipation of making a purchase, features to consider include but are not limited to the following:

- Screen size
- Ease of use
- Voice directions and street names
- Whether the unit features preloaded maps
- Reputation of the company relative to product quality and customer support

Geo-Code Photographs by Means of GPS

> When you "geotag" photos, you are adding the latitude, longitude, and altitude information into the image file. . . . Nikon has been the leader in creating cameras with the GPS receiver built in. Cameras such as the Nikon Coolpix P6000 13.5MP Digital Camera automatically add the geo-tagging information to photos without added work. (Geotagging George, 2009, November 21, n.p.).

Photographic surveillance images must document subject identification, location, and activity. Most digital cameras and camcorders date and time stamp images, and some cameras feature a built-in GPS receiver to geo-tag (geo-code) images. The built-in receiver records the GPS coordinates and elevation of the camera at the time it recorded the image. At the time of this writing, most digital cameras feature no built-in GPS receiver. The alternative is using an auxiliary geo-tagging GPS unit, if one's camera accepts such technology.

At the time of this writing, Nikon offers the auxiliary GP-1 GPS positioning device that is compatible with several Nikon digital single-lens reflex (DSLR) camera models. Each time the specialist records a photographic image, the GP-1 geotags it to document the camera location relative to latitude, longitude, altitude, and satellite time-of-day. B & H Foto & Electronics Corporation (2010, n.p., *Nikon GP-1 GPS Unit*) describes the Nikon GP-1 GPS Unit as follows:

> The Nikon GP-1 GPS Unit allows you to "geotag" your images with valuable information such as latitude, longitude, altitude and time information. For those who are on the go such as outdoor photographers, nature shooters, climbers, sports enthusiasts, news hounds, surveillance people, real estate agents and many more, this item provides a valuable way to accurately document when and where you shot a specific photo.

Many digital pocket cameras geo-tag images–they record the time, latitude, longitude, and elevation for every picture recorded and stores the information in the EXIF area of the image files. When using a DSLR camera or camcorder lacking a GPS recorder, start and end each surveillance by recording an overview image of the subject area using a digital pocket camera that geo-tags each image. Using a digital pocket camera for this purpose is less desirable than every image containing GPS coordinates, but it does reliably document the location and the time that surveillance began and ended.

Periodically research this topic because electronic and communication technologies advance rapidly and the future likely will see more cameras featuring a GPS based geo-tagging capability.

Chapter 4

TECHNIQUES AND METHODS OF MANUAL CLANDESTINE PHOTOGRAPHY

Surveillance photography is an advanced technique used for obtaining information about an individual or an installation under a full range of threat, weather, and terrain conditions. (FM 31-20-5, 1993, March 23, pp. C-10–C-11, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*)

Surveillance activities may involve highly specialized techniques and equipment that require technical training and knowledge and are best accomplished by trained specialists. . . . The successful capture of images sufficient for identification of depicted individuals and/or objects (e.g., license plates) will require close attention to the selection and appropriate use of equipment. (*Forensic Science Communications, Vol. 4,* No. 2, 2002, April, n.p., *Surveillance Photography SOP.*)

INTRODUCTION

Photographing people under some circumstances requires a warrant based upon probable cause. For that reason, a section of this book addresses legal issues and most subjects appearing in this book are people the authors know (e.g., colleagues, friends, and family members). Moreover, in some instances, a subject is one of the authors. No subjects of a live criminal investigation appear in this book.

The previous two chapters provided a foundation to support the information in this and subsequent chapters. This chapter discusses and illustrates what is typical and what is possible relative to manual clandestine photography. The surveillance specialist employs conventional photographic methods but also goes beyond the norm to record photographic images under challenging conditions. To record photographic images under low-light con-

ditions and from extreme distances, the specialist breaks many rules of photography and utilizes unorthodox and hybrid methods. The specialist does things that conventional photographers do not and should not do.

This chapter presents pictures taken in the field during daylight hours and at night using ambient illumination. Some nighttime illumination is natural and some is manmade. Additionally, this chapter presents short-range indoor pictures, intermediate and long-range pictures recorded in the urban environment, and pictures recorded from extreme distances in the semirural environment. This chapter presents pictures of people recorded from as close as 1.83 meters (6 feet) and from as far as 1.61 kilometers (1 mile). This chapter provides illustrations featuring the level of image quality that is typical of photographic images acquired during clandestine and covert operations.

When selecting pictures to use for illustration purposes, emphasis was on images recorded under typical field conditions, not ideal conditions. By selecting images recorded under typical conditions, good or bad though the conditions may be, the pictures adequately serve their intended purpose. The pictures serve their intended purpose by providing the reader with examples that are realistic relative to what they can expect to record in most instances using the techniques and methods presented in this book. The reasoning was that there is little benefit to showing images recorded under ideal conditions using daytime optics and image intensifier night vision technology when rarely such conditions exist.

Mission-specific needs determine appropriate photographic equipment and methods. The nature of a case determines if one will record still images, moving video images, or both. Moreover, case specific needs determine if the surveillance specialist needs a short, moderate, or extreme telephoto lens, exceptionally fast (large aperture) lens, daytime optics or if photographing with an image intensifier night vision device (NVD) is necessary.

Finally, circumstances determine if the surveillance specialist needs conventional photographic equipment or specialized apparatus. Some of the apparatus featured in this book are one-off custom products made specifically for manual clandestine photography. The custom products are not commercially available and for that reason, in-house or contract fabrication of the items is necessary.

When referring to extreme telephoto lenses, *extreme* is the operative word. One high-magnification lens featured in this book is the observatory class 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). The 12″ Meade LX90-SC telescope recently replaced the LX90GPS;

ACF stands for Advanced Coma-Free.[1] The 12″ LX90GPS and the LX90-ACF telescopes are Catadioptric lenses featuring a total net weight of 35.83 kilograms (79 pounds). The telescope weighs 27.22 kilograms (60 pounds) and the tripod weighs 8.62 kilograms (19 pounds).

When used by means of the direct coupling (prime focus) method, these telescopes permit recording detail such as subject identification (i.e., facial recognition) and legible vehicle number plates (license plates) from considerable distances. Indeed, these telescopes permit recording such detail from distances of 1.61 kilometers (1 mile) and more depending on atmospheric conditions. At night, when used with a high quality third-generation (Gen 3) image intensifier night vision device, these telescopes permit photographically recording recognizable images of people and legible vehicle number plates from distances of 1.21 kilometers (0.75 mile), and more depending on the method used.

The surveillance specialist serving on an advanced photography team must be photography literate, skilled, and have a suitable assortment of photographic equipment. The specialist needs digital single-lens reflex (DSLR) cameras, high-magnification telephoto lenses, fast (large aperture) telephoto lenses, high-definition camcorders, professional grade night vision devices, an assortment of standard and specialized accessories, and camera supports including robust tripods. Additionally, they must be skilled in the clandestine arts (e.g., urban and rural surveillance, camouflage and concealment, infiltration and exfiltration methods, and the use of pretexts).

Tactical skills are as essential as photographic skills. As stated in Chapter 1, photographic skill without supporting tactical skills is as useless as a high-tech aerial camera without an aircraft to take it aloft. In each instance, the means to place the camera where needed is absent. The surveillance specialist cannot record useful photographic images until placing the camera where it needs to be. That requires infiltration (getting in), recording photographic images, and then exfiltration (leaving the area) while at all times avoiding detection and leaving nothing behind to reveal that somebody was in the area. Chapter 6 discusses and illustrates tactics and strategies for manual clandestine photography operations.

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1. Meade Instruments Corporation describes the LX90-ACF telescope series as follows: "LX90-ACF. For the truly discerning astronomer . . . there is Meade's Advanced Coma-Free (ACF) optical system. ACF takes all of the features of our SC [Schmidt-Cassegrain] models and then ups the ante. With it's technologically superior optical design, ACF gives a flatter, coma-free field-of-view with pinpoint images all the way to the edge of the field, rivaling Ritchey-Chrétien performance at a fraction of the cost" (Meade Instruments Corporation, 2009, *LX90™, the best of both worlds*).

VANTAGE POINT SELECTION

Whether the operation is urban or rural, a preliminary survey (reconnaissance) must precede a static photographic surveillance operation. It is during the preliminary survey that the surveillance specialist selects a vantage point and determines what photographic equipment is required. The specialist must personally do the preliminary survey because he or she can view circumstances through the eyes of a photographer. A vantage point suitable for direct viewing is not always appropriate for photographic surveillance.

When selecting a vantage point for static photographic surveillance, the specialist considers issues such as but is not limited to the following

- The vantage point must provide concealment and an unobstructed view of the subject area.
- The vantage point must feature a means of traveling to and from the site and offer escape routes, defensive positions, and emergency rendezvous locations. If the terrain between the subject and vantage point is hostile that makes a rapid reactionary assault by the subject difficult in the event of discovery.
- The vantage point should be located where a subject will not expect a clandestine photography team to be. For example, a subject is unlikely to scrutinize a large shallow swamp that is impassable to conventional watercraft. Therefore, a camouflaged kayak that moved into the area under cover of darkness will tend to go unnoticed (refer to Figures 6-9, 6-16, 6-18, 6-20, and 6-21 in Chapter 6). The Klepper Commando II 545 Military Folding Kayak when loaded to capacity requires only 21 centimeters (9 inches) of water. Empty except for themselves and a gyro-stabilized camera, the authors have used the Klepper military kayak in little more than 15.24 centimeters (6 inches) of water.
- The vantage point should be where environmental conditions decrease the likelihood of detection. For example, at night, if in line with distant background lights, the subject may incorrectly attribute an unintended light reflection as being associated with the distant lights. Similarly, if using an infrared (IR) illuminator is necessary, and conditions permit, operate it from a location where distant background lights will obscure it or leave the subject believing that the red glow is associated with the distant lights. During long-range and ultra-long-range night vision photography, never use an infrared (IR) illuminator from the camera location. Chapter 5, *Night Vision Photography for Clandestine Operations,* discusses the reasons for this.

- For daytime photography, the vantage point should be ideally located relative to lighting direction during the course of the day. Lighting from the front and somewhat to the side of the subject is best. Avoid photographing towards the sun because light scatter is severe and the subject is a silhouette. More than one vantage point may be necessary and that can require switching vantage points during the course of the surveillance (not recommended) or assigning more than one photography team.
- For photography using an image intensifier night vision device, the vantage point should be ideally located relative to the direction of moonlight and other illumination sources.
- To avoid photographing through the near ground thermals that degrade image quality, the specialist seeks a high elevation vantage point.
- Seek a thermal-friendly vantage point (e.g., thermals over water are minimal and thermals over grass are less than over bare earth and asphalt).

SHORT-RANGE PHOTOGRAPHY AND VIDEOGRAPHY

> Secret photography involves a person or persons being unaware that they are being intentionally photographed. It is sometimes called "covert photography," but this is a term used mostly among professional investigators. (Wikipedia, 2010, September 5, n.p., *Secret Photography*)

Introduction

For purposes of this discussion, consider short-range manual clandestine photography to be from as close to the subject as 1.83 meters (6 feet) to as far as 30 meters (100 feet). Realize, however, that no consensus exists as to what constitutes short, intermediate, long-range, and ultra-long-range photography with the terms used loosely in this book.

In some environments, people using cameras and camcorders is the norm such as at sporting events, rodeos, public parks, amusement parks, swimming beaches, and at the zoo. In other instances, somebody with a camera or camcorder goes unnoticed not only because many people have cameras and camcorders but because of the density of the pedestrian traffic. For example, clandestinely photographing somebody from close range is easy at Times Square in New York City. In such instances, a concealed camera or camcorder often is not necessary. Nevertheless, discreetness remains necessary. Discreetness is necessary because even though the circumstance is such that people are using

cameras and camcorders, the subject is not the focus of attention; the specialist must photograph the subject without appearing to do so.

In some instances, the specialist can use the zoom feature of a camera or camcorder and work from a distance that precludes alerting the subject. In other instances, the specialist can appear to be photographing a loved one, friends, or family members while actually filming past them at full zoom, in fact filming the subject. In the case of a supposed loved one or friend, they can engage in behavior that makes the pretext (subterfuge) believable.

Using a high-definition camcorder, a specialist sitting at a picnic table with the camcorder viewing between a food basket and beverage cooler can discretely film a subject from close range or from a considerable distance. With the Canon VIXIA HV30 high-definition camcorder at full zoom with the 1.7x tele-converter lens attached, the specialist can record subject identification from as far as 274 meters (300 yards) (refer to Figure 2-34 in Chapter 2 to view this camcorder). Although newer models are available, the authors continue to use this camcorder because it has been reliable.

Indoor short-range photography and videography often, but not always, requires camera/camcorder concealment. Common indoor situations include following a subject into a shopping mall, retail store, restaurant, or bar during foot surveillance or after they park and alight from their vehicle. In the event that the subject takes a seat in a bar or restaurant, the surveillance specialist takes a seat and discretely engages in videography. Circumstances determine if camcorder concealment is necessary.

In some instances, the surveillance specialist finds the subject already at the location of intended photographing, that being a circumstance frequently encountered by private investigators. An example is a disability claimant secretly working for cash payments so no record of their employment exists. In other instances, the surveillance specialist precedes the subject into a business and is ready to activate a camcorder when the subject arrives. An example is the person working as a bartender for cash payments while off their regular job collecting Workers' Compensation benefits. Such a subject is likely alert for surveillance by a private investigator while driving to work and may scrutinize people entering the bar while on the job. They are less likely to be suspicious of patrons already seated at the bar or at a pub table when they arrive for work, especially if they learn that the supposed patron has been there for an hour or more. The same rationale applies to criminal investigations and intelligence gathering.

From the Second World War through the Cold War to today, camera concealment for short- and moderate-range manual clandestine photography has been necessary. Today, the camcorder predominates for certain applications. Either a camcorder looks like something other than a camcorder or it

operates from within the confines of an innocuous container. Relative to the latter, refer ahead to Figures 4-3, 4-4a, and 4-4b and compare them with Figure 1-4 in Chapter 1.

During the 1940–1945 German occupation of the Netherlands, clandestine photographers used cameras concealed in briefcases, boxes, bicycle panniers, and from under overcoats (goDutch.com, 2005, April 7, n.p., *War-time Clandestine Photographer Taconis*). Other early camera concealment methods included a woman's beauty case (cosmetics), doctor's bag, and men's shoulder bag. (Regarding the doctors bag, there was a time when doctors made house calls to treat patients.)

Technology and photographic equipment have improved over the years, but some aspects of clandestine tradecraft remain largely unchanged. This became evident with the June 27, 2010 arrest in New York (USA) of ten individuals on suspicion of working as spies for the Russian Federation's external intelligence agency SVR (Sluzhba Vneshney Razvedki). The Russian spy ring was using Cold War methods. The case revealed that although with time the tools of espionage get better, clandestine tradecraft changes very little. The Old Testament of the Christian Bible reveals that the spies operated much the same back then as they do today. The difference is, today's spies have motor vehicles, cameras, radios, and computers. Then, as now, females are essential in the world of espionage (and investigation) because it is a people business. Speaking to the male versus female issue, in his book *Introduction to Business and Industrial Security and Loss Control,* Raymond Siljander (2008, p. 19) explains:

> . . . regarding male versus female investigators, who makes a better investigator, men or women? It is impossible to say because it is more a question of the individual's qualifications than their gender. However, it is accurate to say that generally anything a man can do a woman can also do, and in certain instances women enjoy an advantage. One private detective agency, whenever it was necessary to interview a subject's neighbors using a pretext such as updating the person's credit, always sent an attractive female. . . . Stereotypes relative to gender roles persist and, in the investigative field, that is often an advantage.

Circumstances continue to require photography and videography while in close proximity to a subject and that often requires disguised or concealed cameras and camcorders. Stated earlier, camera-to-subject distance can be as little as 1.83 meters (6 feet). The surveillance specialist utilizes a number of creative methods to accomplish short-range photography and videography depending on circumstances, which vary considerably. What works in one situation may not work in another situation.

When photographically documenting the subject from short-range, the surveillance specialist can use a micro spy camera/camcorder, a consumer grade camcorder, or a digital pocket camera in photo or movie mode. Another option is a cell phone camera. They are becoming increasingly prevalent, efficient, and useful for clandestine applications (refer to Figure 2-5 in Chapter 2).

Micro Spy Cameras/Camcorders: Pinhole Camera

Micro spy cameras/camcorders cannot provide the image quality that their larger counterparts are capable of but they serve a useful purpose. These minuscule cameras permit manual clandestine photography and videography while in close proximity to the subject, and they permit doing so with little likelihood of detection.

Adding to the value of moving video images is their showing the subject's body language, "The gestures, postures, and facial expressions by which a person manifests various physical, mental, or emotional states and communicates nonverbally with others" (Body language, *The American Heritage Dictionary of the English Language, Fourth Edition,* n.d., n.p.).

The surveillance specialist uses micro cameras and camcorders for short-range situations, circumstances where distance is too limited to provide cover and the situation proscribes using a conventional camcorder in a concealment container. For clandestine purposes, ingenious disguising results in micro camcorders appearing to be such things as, but not limited to, a cigarette lighter, car key fob, writing pen, wristwatch, clothing button, and sunglasses (see Figure 4-1). Some micro camcorders, not disguised, are simply very small. Camcorders in this class perform well when lighting is good (see Figure 4-2).

Exercising care is necessary when selecting a micro spy camcorder for a particular mission because not all circumstances accommodate all methods of camcorder disguise. What appears to be an automobile key fob or ink pen is unlikely to capture attention in most environments. A camcorder disguised as a cigarette lighter is likely to attract attention in areas designated non-smoking.

Research the market before purchasing a micro camcorder because some products record higher resolution images than others do. Be wary of online retailers that malign their competition.

Figure 4-1. Micro spy cameras/camcorders permit surreptitiously recording moving video images (and still photographs) while in close proximity to the subject, and doing so with little likelihood of detection. *Left to right:* PI CamStick camera/camcorder also called a gum stick camera; pen camera/camcorder; and car key fob camera/camcorder. The Cross ballpoint pen on the right is included for size reference–it contains no camcorder or camera.

Conventional Camcorders Concealed

> Often a team's task on the street is to get pictures of the people they are tailing or of objects like suspected dead drop sites and entrances to safe houses. A traditional and time-proven sneak-photo device is a woman's handbag, rigged to let her aim from under her arm so that the invisible aperture in the bag lets the light into the lens of the camera in her bag when she activates the shutter by pressing an invisible button. A hundred other similar devices can be used; rucksacks, briefcases, bowling bags, tennis racket carriers . . . whatever fits the cover for your team. (Johnson, W. R., 2009, p. 77)[2]

2. "The original 1987 edition of *Thwarting Enemies at Home and Abroad* has been out of print for many years, but it has continued to be sought after by professionals, scholars, and others interested in the real world of intelligence. Georgetown University Press has republished this book to make sure that William R. Johnson's seasoned wisdom about the principles and tactics of counterintelligence is widely available once again. . . . We have republished the original text in full and unaltered except for corrections for grammar and punctuation that naturally slip through in an original edition" (Publisher's Note, 2009, p. ix).

Figure 4-2. Disguised micro camcorders make short-range videography possible with little risk of detection. The surveillance specialist recorded these images using the 8GB car key fob camcorder featuring video resolution of 640x480 at 30 fps. The camcorder provides date and time stamping. The quality of the moving video images this camcorder records are better than the quality of these still images extracted from the moving video images. *Upper image:* The restaurant employee is working approximately 3.05 meters (10 feet) from the surveillance specialist sitting at a booth. *Center image:* Results are best when the camcorder lays motionless on a flat stable surface as this grocery store image attests. *Lower image:* The man and woman are approximately 2.13 meters (7 feet) from the surveillance specialist who was handholding the camcorder; circumstances do not always permit laying the camcorder on a motionless flat surface. Images cropped top and bottom only.

Purse Camcorders

Conventional high-definition camcorders provide higher quality images than micro camcorders are capable of providing, especially under low-light conditions. Appropriate disguising permits using conventional camcorders in short-range situations. Private investigators (PIs), for example, commonly work cases requiring short-range videography, cases such as personal injury insurance fraud and Workers' Compensation fraud. For that reason, PIs are resourceful and develop creative methods for concealing camcorders for short-range use.

Private investigators Johnston and Dana Blakley of Investigative Training[3] generously provided illustrations that show a camcorder concealment method they use, the method being creative, efficient, and effective (see Figure 4-3).

Relative to the images in Figure 4-3 Johnston Blakley offers the following explanation:

> For indoor video recording, a tiny camcorder secreted in a bag offers several advantages over small fixed lens camcorders such as the Sony Webbie cam MHS-PM1 or micro camcorders. This method permits the surveillance specialist to covertly film the Subject at close range, and it permits zooming in on the Subject from across a large store, auditorium or restaurant where a close up perspective is required. Close up perspectives from a distant position are required when facial identification is necessary, when items that the Subject or others relating to the Subject need to be identified (weapons) or even when documents need to be read (papers, nametags, money denominations/exchanges). This setup is also useful for on-foot outdoor filming when holding a naked camera to one's eye is not feasible. . . . The surveillance specialist uses the pocket television/TV (TFT version for high quality) to view both the Subject and the functions of the camcorder when opening the camcorder LCD monitor is not possible while the camcorder is in the bag. The operator uses a minuscule shrink-wrapped TV channel transmitter with a thread like antenna powered by a 9-volt battery or a stack of 3-volt coin batteries for even smaller setups. The transmitter is plugged into the video-out of the camcorder and sends the video up approximately 500 feet line-of-sight/LOS (with the antenna at least partly outside of the bag) to the matching signal on the pocket TVs slide band. *Side note:* A simpler way to do this is to get a bag with an accordion pocket (do not know of any other way to describe a pleated/stretchy pocket) that is lined up with the LCD display, cut the wall between the bag and the pocket. When filming, open the LCD into the pocket and turn the LCD upright. Look down into the pocket and film. This is not as good for tight covert setups but the Webbie can

3. Investigative Training. North Palm Beach, Florida (USA). Website: www.investigativetraining.org.

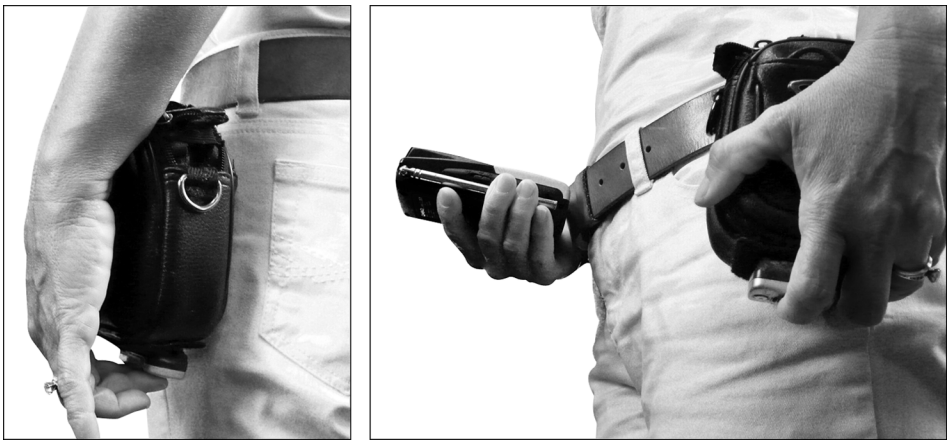

Figure 4-3. This purse/pouch accepts the Canon Elura 50 camcorder controlled by means of a LANC remote controller. The lens of the camcorder is located just beyond the orifice (hole) in the upper portion of the purse/pouch. When providing these images, Johnston Blakley explained that, "With a strap it can be an evening purse and without a strap it can clip onto a belt for the lads. A small camera form-fitting purse is always more nimble than a big floppy one. The LANC controls the zoom lens, start/stop and record functions, and it can turn off the camera to extend battery life." Observe that in this instance the camcorder faces to the rear of the surveillance specialist, that being a good tactic. From the subject's perspective, the specialist does not appear to be interested in them, and neither does the subject see the specialist's face for later recognition. Additionally, the subject cannot see the pocket television/TV in the specialist's hand. Revisiting Figure 1-4 in Chapter 1 leaves it apparent that some clandestine tradecraft has endured over the years although technology has improved efficiency and effectiveness. Technology offers new and improved tools but many aspects of clandestine tradecraft remain largely unchanged since the Cold War. Images courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

> handle them. The sideway pressure on the camera from the accordion pocket will require you to fix the camcorder tightly in the main part of the bag. Adjusting the brightness of the LCD may be required as looking down into the pocket can make your face somewhat bluish in low-light environments. Alternatively, drop some mesh onto the screen. The larger 3.5″ LCDs may not be as good for this. (Johnston Blakley, personal communication, January 13, 2010)

Modified Diabetic Cooler/Organizer

Cameras have become better but Cold War tradecraft perseveres. The modified Diabetic Cooler/Organizer being gender neutral is a way for men to do what the women have so successfully done for years. It narrows the tradecraft gender-advantage gap.

The Sony bloggie™ HD PM5 Camera replaced the Sony Webbie HD™ MHS-PM1 Camera. Both camcorders are excellent for short-range clandestine videography although the bloggie is image stabilized while the Webbie is not. The bloggie camera features 1920x1080 HD recording and 5MP still images. At the time of this writing, surveillance specialists continue to use the discontinued Webbie, because of its reliability and simplicity of operation. In fact, upon learning that Sony discontinued manufacture of the Webbie, the authors purchased backup cameras.

Using the Sony Webbie and bloggie camcorders undisguised is preferable when circumstances permit because the surveillance specialist has greater control; he or she can position the camcorder in various positions. Nevertheless, some short-range situations require concealing the camcorder. Women have the advantage of concealing cameras and camcorders in purses, a method practiced during the Second World War and throughout the Cold War. Men do not carry purses and, therefore, other concealment methods are necessary. The chosen concealment method must be gender neutral and suitable for discrete use in virtually any environment.

The modified diabetic insulin cooler/organizer is not gender specific and in most environments, it is not out of place. As such, it permits clandestine videography by men and women in almost any environment. Concealing the camcorder in the manner discussed here somewhat restricts freedom of use, but it is effective for close-range surreptitious applications (see Figures 4-4a to 4-7). A modified diabetic insulin cooler/organizer performs best when lying flat on a horizontal surface such as a bar or tabletop although lap use works.

A neutral density filter covers the hole in the diabetic insulin cooler/organizer through which the camcorder lens views, filter density selected according to the level of illumination. A brightly illuminated environment requires using a two f-stop light loss neutral density filter to obscure the camcorder lens. Conversely, an environment such as a barroom featuring subdued illumination requires using a one f-stop light loss filter to let more light reach the camcorder lens. Fortunately, a dark environment requires less filter density to obscure the lens. In very dark environments, operating the camcorder with no filter is necessary.

When an environment is so dark that the surveillance specialist must operate the camcorder without a neutral density filter obscuring the lens, the illumination level is low enough that somebody observing the lens is unlikely. This assumes, of course, that the specialist darkened the front of the camcorder using black photo masking tape or black gaffer tape. It also assumes that the specialist darkened the area around the lens using black tape or a black permanent marker. *Avoid touching the lens with a permanent marker!*

Figure 4-4a. This modified diabetic insulin cooler/organizer is one method for concealing the Sony Webbie HD MHS-PM1 high-definition camcorder or its successor the Sony bloggie HD PM5 Camera. This concealment methods works well for situations requiring covert short-range videography. A rectangular shaped neutral density filter covers the opening in the case through which the camcorder films. To make a rectangular filter from a round filter, use a belt sander. During the sanding process, frequently dip the filter in water to keep it cool. After modification, this three-compartment container features two compartments. Remove the partition separating the center and bottom compartments but leave the zipper in place. Cut a piece of wood sized to fit into the case and then use a router to create a cradle for the camcorder, a cradle permitting articulation of the 270° Swivel Lens. In use, discretely raise the top of the cooler a short distance, reach in to activate the camcorder and properly frame the subject, and then close and partially zip the top and let the case sit undisturbed. Because this is a diabetic insulin cooler/organizer, employ a suitable pretext to justify having it should that become necessary such as for getting past security officers. Place items in the top compartment to support the pretext of being diabetic (e.g., glucose meter, lancing device, diabetic test strips, and a self-testing logbook with entries). Consider wearing a medical alert necklace and/or bracelet to support the pretext, although that carries with it a risk. The risk is the medical alert emblem resulting in inappropriate treatment by emergency response personnel in the event of an incapacitating medical emergency (unless one is diabetic).

When recording the subject from a seated position inside a building during daylight hours, sit next to a window if circumstances permit. Sitting next to a window provides two benefits. First, from the subject's perspective, the surveillance specialist and camcorder are backlit and that diminishes the quality of the subject's view. Second, by sitting next to a window the specialist is not filming towards the window, which results in higher quality video images.

Figure 4-4b. This modified diabetic insulin cooler/organizer conceals a Sony Webbie HD MHS-PM1 high-definition camcorder. Black fiberglass insect screen covers the opening through which the camcorder lens films. Use no neutral density filter with this screen. The screen softens the image but not to an objectionable extent as the upper image attests. Another option is to use a neutral density filter covered by black aluminum insect screen–image quality is excellent. The screen gives the appearance of texture similar to the material of the organizer, the glass behind the screen not being particularly apparent except when angles result in light reflection from the glass. Each surveillance specialist should experiment to find preferred methods for concealing the camcorder lens in various environments.

Figure 4-5. The Sony Webbie HD camcorder concealed inside the modified diabetic insulin cooler/organizer permits short-range videography with little likelihood of detection by the subject or anybody else in the vicinity. This image cropped on the right side only. The surveillance specialist recorded this individual from the table closest to the beverage dispenser with a two f-stop light-loss neutral density filter concealing the camcorder lens (no insect screen covering the filter). The male specialist who filmed this individual is nearing retirement age and unlikely to be the subject of scrutiny or suspicion. People are unlikely to suspect that somebody his age is engaged in clandestine activity.[4] In America, age bias exists–surveillance personnel can exploit that fact.

4. Whenever possible, those in the investigative and intelligence fields should exploit the advantages that age, gender, ethnic, and attractiveness bias make possible. Many studies address such biases. How do practitioners of the clandestine arts exploit these biases? One example is a young, attractive, and vivacious female sitting at the bar in a tavern or cocktail lounge tastefully capturing the interest of other patrons. Meantime, the nondescript older male or female surveillance specialist sits unnoticed at a remote pub table discretely operating a concealed camcorder. The attention-getting person permits the quiet nondescript person to go unnoticed. Magicians use patter not just to make their performance interesting, but as a form of distraction (misdirection). People concentrating on the verbal patter tend to overlook much of what the magician's hands do, especially when movement is slow. The slowly moving magician's assistant especially tends to go unnoticed. Justin Draeger, Assistant Director for Communications of the National Association of Student Financial Aid Administrators (NASFAA) explains that, "It's a myth that a human mind can concentrate on more than one thing at a time" (Draeger, 2007, November 28, n.p.). To the extent that people notice a remarkable person, the unremarkable person goes unnoticed.

Figure 4-6. The subjects are aware of the surveillance specialist sitting with a drink at the opposite end of the bar. However, they have no idea he is using a high-definition camcorder to film them, periodically zooming in for a close-up view. The specialist used the Sony Webbie cam MHS-PM1 high-definition camcorder concealed inside the modified diabetic insulin cooler/organizer. The specialist used a one f-stop light-loss neutral density filter to conceal the camcorder lens. The upper image is a wide angel view while the lower image is a full zoom view. Images not cropped. These images, extracted from the moving video images, feature usable quality.

If after entering an indoor environment it becomes apparent that the neutral density filter on the modified diabetic insulin cooler/organizer is inappropriate relative to the level of illumination, switch filters. If necessary, go to the bathroom to switch filters although that usually is not necessary. Removing the filter from the case and replacing it with a filter of greater or lesser density without somebody observing the act is surprisingly easy, little sleight of hand is required. Enter the area with alternate filters readily available such as in a shirt pocket.

Figure 4-7. The surveillance specialist used the Sony Webbie cam MHS-PM1 high-definition camcorder concealed inside the modified diabetic insulin cooler/organizer to film this individual. The specialist used a two f-stop light-loss neutral density filter to conceal the camcorder lens. The chair back located between the subject and the camcorder concealment container serves as visual disruption to make the container less conspicuous. Additionally, placing objects near the camcorder container creates visual clutter, which makes the container less obvious; rather than sitting alone the camcorder container is one of several objects clustered together. Use objects such as flatware; beverage containers; condiment organizer; napkin dispenser; salt, pepper, and sugar dispensers; catsup, mustard, and salad dressing dispensers; and a displayette or cardholder. An appropriate book lying on the tabletop adds visual clutter and is more likely than the camcorder concealment container to capture the attention of people walking past the table; curiosity compels people to read the title of the book as they pass.

Undisguised Camcorder Applications

For close-range videography, Johnston Blakley, owner of Investigative Training and owner of a private investigation company, favors using the Sony Webbie and Sony bloggie undisguised. He has mastered the art of using them without a means of disguise or concealment. During use he handholds the camcorder, lays it on a flat surface, or he props it in various positions and lets it record activity while he appears to be engaged in an unrelated task consistent with the environment (see Figures 4-8 to 4-12).

INTERMEDIATE-RANGE MANUAL CLANDESTINE PHOTOGRAPHY

For us, in Phoenix (Arizona, USA), the usual distance for urban stationary surveillance varies from one situation to the next. In a residential neighbor-

Figure 4-8. Using the Sony Webbie cam MHS-PM1 the surveillance specialist recorded this subject with the camcorder lens viewing through an opening of a grocery store shopping basket. Image courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

Figure 4-9. Holding the Sony Webbie cam MHS-PM1 at his side, the surveillance specialist filmed the subject through space between hanging merchandise in a shopping mall while remaining out of view of the subject. Image courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

hood, 2-3 blocks is the usual maximum, unless it is an open street and a long eye permits us to see the driveway. Typically, we make observations from 1–2 blocks. Many times, we just watch for a vehicle to leave a location so

Figure 4-10. The Sony Webbie cam MHS-PM1 is lying on the table in a bar. The beverage container, napkin wrapped flatware, and peppershaker surrounding the camcorder provides visual clutter (distraction) to make it less noticeable. Images courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

> 3–4 blocks may work. Right now, I am in Tucson (Arizona, USA) and in this semirural environment, I am observing the subject's residence from about one-half mile (0.80 kilometer) ridge to ridge. (Detective Darin Fredrickson, personal communication, April 4, 2010)

In Phoenix, Arizona (USA), the typical residential block measures approximately 100 meters (109 yards) plus or minus with the dimensions of oblong city blocks varying considerably. Therefore, Detective Fredrickson[5] is doing most stationary surveillance from a distance of 100-200 meters (109-218 yards) and sometimes from as far as 400 meters (437 yards). Keep these distances in mind when examining the illustrations in this section.

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5. Detective Darin Fredrickson, M.Ed., CPP, is a 19-year veteran with the Phoenix, Arizona (USA), Police Department, and President of Team Guardian, LLC, Investigation and Security Specialists (www.teamguardian.us).

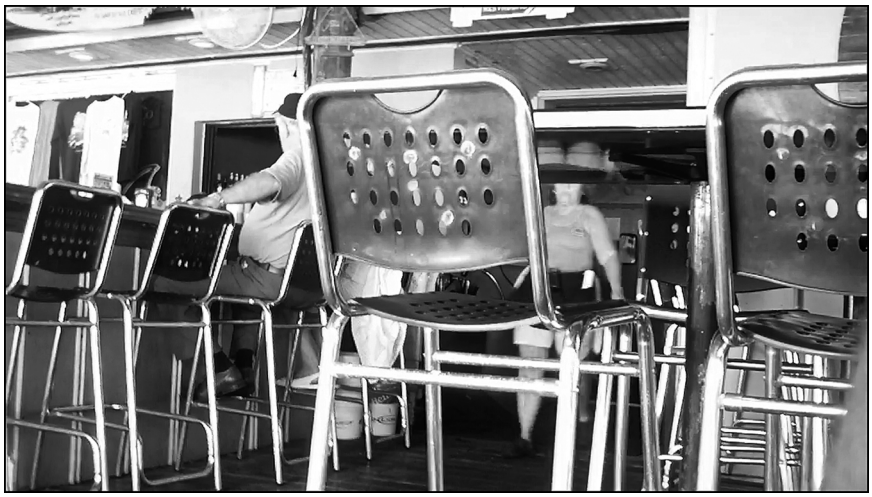

Figure 4-11. The Sony Webbie cam MHS-PM1 lying on the chair between the surveillance specialist's legs recorded this view of the subject. After properly framing the subject, men and women wearing jeans or slacks can use a lap napkin to conceal the camcorder. Women can use their skirt to conceal the camcorder. Images courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

While the above distances are typical for the urban environment, Detective Fredrickson confirms that some urban environments feature semirural areas wherein observer-to-subject distances are considerably greater (e.g., 0.80-kilometer, 0.50-mile in the Tucson private investigation case he was working).

Generally, the surveillance specialist finds avoiding detection easier in the urban environment than in the rural environment. The urban environment tends to overwhelm people's visual and auditory senses. The urban environment features countless shapes, colors, dull and reflective surfaces, varied object sizes, irregular angles, countless sounds of different intensity, and the environment is in motion. Additionally, the urban environment features a dense human population that is in motion. For these reasons, avoiding detection is usually easier in the urban environment than it is in semirural and rural areas.

The circumstances of manual clandestine photography in the urban environment are highly varied with some situations being more challenging than others are. Usually, in the urban environment, the surveillance specialist needs no more than a 400mm telephoto lens when using a digital single-lens reflex camera. In many instances, a 70-300mm zoom lens is adequate (refer to Figure 6-34 in Chapter 6). As for videography, a consumer grade camcorder is often adequate. The Canon VIXIA HV30 HD camcorder with the

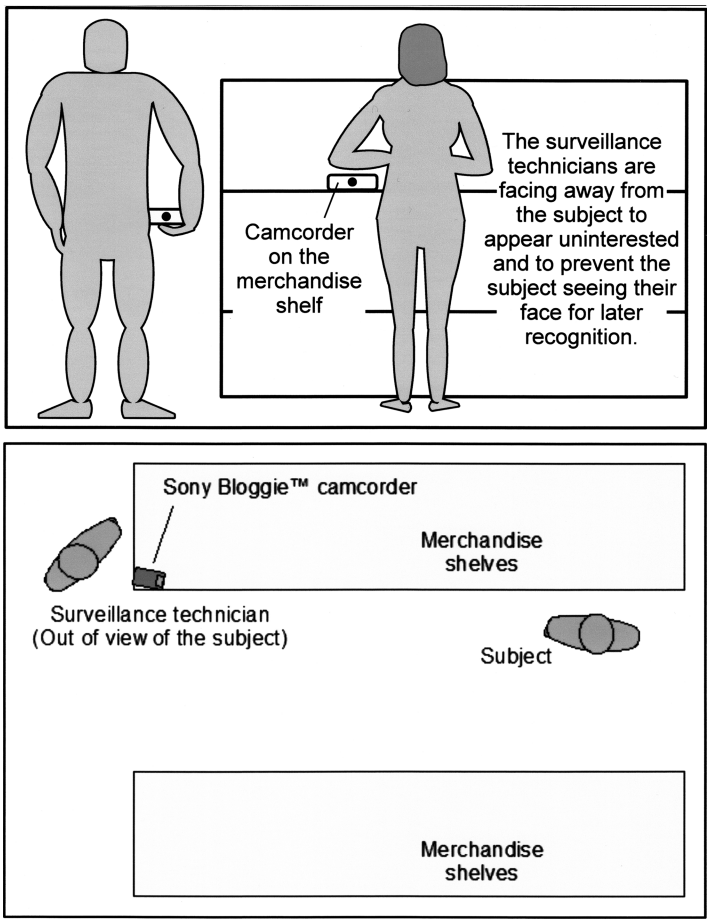

Figure 4-12. In many instances, the surveillance specialist uses the Sony Webbie cam MHS-PM1 or its successor the bloggie HD PM5 camcorder without concealing them inside an innocuous container. These drawings show methods taught by Johnston and Dana Blakley of Investigative Training. *Upper left image:* The specialist can direct the camcorder forward or backward while holding it in this manner. Facing away from the subject and directing the camcorder backward is a good technique because the subject is less likely to become suspicious and neither is the specialist's face visible to the subject. *Upper right image:* The specialist laid the camcorder on a merchandise shelf with her back to the subject. *Lower image:* The specialist laid the camcorder on merchandise or on a shelf providing the camcorder a view of the subject while himself remaining out of view of the subject.

1.7x tele-converter lens records recognizable images of people and legible vehicle number plates from 274 meters (300 yards). Camcorder stability is important! Refer to the basic photo-surveillance package illustrated in Figure 2-36 in Chapter 2.

Figure 4-13a. *Camera-to-subject distance:* 106.98 meters (117 yards). This distance is not atypical for urban surveillance although greater distances are common. The surveillance specialist photographed this subject using the 600mm f/7.5 Celestron 80ED refractor spotting scope (achromatic telescope) by means of the direct coupling (prime focus) method using the camera mirror lock-up feature and remote shutter release (refer to Figure 2-11 in Chapter 2, center image, to view this camera-adapted telescope). The camera connects to this lens by means of a T-Adapter and T-Ring. This achromatic (two lens elements) telescope features fully multicoated optics consisting of low dispersion (ED) glass. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *ISO:* 100. *F-ratio (aperture):* f/7.5. *Shutter speed:* 1/200 second. *Atmosphere:* Clear day.

In Chapter 2, subheading *Long Focus Lens,* discussion addressed the fact that economical yet quality refracting telescopes are a suitable although not comparable alternative to expensive name brand telephoto lenses offered by companies such as Canon and Nikon. The next two illustrations reinforce that discussion (see Figures 4-13a and 4-13b). Spend some time studying them and their supporting captions and compare their quality with the following two illustrations recorded using the Canon EF 600mm f/4L IS USM telephoto lens (see Figures 4-14 and 4-15).

Rural surveillance usually involves considerable camera-to-subject distances although exceptions do occur. Sometimes, circumstances are such that the surveillance specialist cannot photograph from a long distance using a high-magnification lens so moving in relatively close to the subject is necessary (see Figure 4-16).

Figure 4-13b. Daytime and nighttime images recorded using a Canon digital single-lens reflex crop-sensor camera with the fully multicoated 480mm f/6 Meade Series 5000 ED 80mm APO 3-element apochromatic refracting telescope featuring a built-in extendable lens shade (80 millimeters is the diameter of the aperture, 3.15 inches). The machined 2″ (50.8 mm) dual speed Crayford style focuser works superbly for critical focusing. Apochrmatic (APO) telescopes outperform achromatic telescopes, although the latter do perform well as illustrated in the previous illustration. *Upper image:* Daytime image recorded from a distance of 274.32 meters (300 yards). *ISO:* 100. *Aperture:* f/6. *Shutter speed:* 1/250 second. *Lower image:* Nighttime available light image recorded from a distance of 210.31 meters (230 yards). *ISO:* 3200. *Aperture:* f/6. *Shutter speed:* 1/6 second. A shutter speed this slow is suitable for photography of this nature, but record numerous sequential images so that some blur-free images result. With a shutter speed this slow, expect about 15–20 percent of the images to be useful, success rate depending on the nature of subject activity. Lower image cropped top and bottom only.

Figure 4-14. *Camera-to-subject distance:* 259.69 meters (284 yards). The lower image is a cropped portion of the upper image, the white oval in the upper image identifying the two men. The surveillance specialist recorded this daytime image from the 11th floor of a high-rise building. The elevated vantage point minimized the likelihood of detection, provided an unobstructed view of the subject area, and it positioned the camera above image degrading near-ground thermals. In the original high-resolution image shot to RAW the number plate of the most distant vehicle is legible, the vehicle located in the upper right corner of the upper image. That is noteworthy considering that focus is on the human subjects, not that vehicle. *Method:* Camera in mirror lock-up mode and operated using a remote shutter release. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 600mm f/4L IS USM super telephoto lens. *ISO:* 100. *F-ratio (aperture):* f/4. *Shutter speed:* 1/80 second. *Atmosphere:* Clear day.

Figure 4-15. *Camera-to-subject distance:* 274.32 meters (300 yards). The lower image is a cropped portion of the upper image. The surveillance specialist recorded this daytime image from across the Mississippi River. In the urban environment, camera-to-subject distance seldom exceeds this range, but greater distances do occur. *Method:* Camera in mirror lock-up mode and operated using a remote shutter release. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 600mm f/4L IS USM super telephoto lens with a 2x tele-converter–effective focal length and f-ratio was 1200mm f/8. *ISO:* 100. *Shutter speed:* 1/200th second. *Atmosphere:* Clear day.

Figure 4-16. Intermediate range manual clandestine photography does occur in the rural environment. Here the surveillance specialist, wearing a Ghillie suite, has assumed a position about 90 meters (100 yards) from the subject. Remaining motionless is essential. Using a digital single-lens reflex (DSLR) camera this close to the subject carries with it the risk that the subject will hear the reflex-mirror action of the camera and become aware of the surveillance. Being downwind from the subject minimizes the likelihood of the subject hearing the camera. The specialist is using a camouflaged Canon EOS 5D DSLR full-frame camera with the Canon EF 300mm f/2.8L IS USM telephoto lens. The telephoto lens sports a Ghillie rifle wrap and an irregular edge camouflage-pattern lens shade extension.

LONG-RANGE AND ULTRA-LONG-RANGE MANUAL CLANDESTINE PHOTOGRAPHY: URBAN AND RURAL

Manual clandestine photography has at least three things in common with astrophotography:
(1) High magnifications and turbulent air,
(2) Low-light levels, and
(3) Considerable benefit from digital post-processing.
(Michael Covington, personal communication, July 24, 2009)

Indeed, for manual clandestine photography, modern optical systems have the ability to reach beyond what atmospheric conditions usually permit.

Introduction

Conventional telephoto lenses and refracting telescopes are suitable for long-range manual clandestine photography. Ultra-long-range clandestine photography requires using high-magnification Schmidt-Cassegrain telescopes (SCTs) with and without application of tele-converters.

A long-range photography capability permits working from a distance that precludes detection by unaided vision or by somebody using any binocular but an ultra-high-magnification model. Additionally, an ultra-long-range capability permits working from distances so great that the vantage point location is unlikely to be the subject of suspicion and scrutiny. For example, a subject is not likely to expect the presence of a photography team on the far shore of a lake 1.61 kilometers (1 mile) away (refer ahead to Figure 4-26).

Previously stated, short- to intermediate-range manual clandestine photography usually occurs in the urban environment although long-range and ultra-long-range photography do occur. Conversely, the rural environment usually requires long-range and ultra-long-range photography, although exceptions occur as the previous illustration attests.

In comparison to urban areas, the rural environment features limited visual variation, an exception being in some regions when autumn leaves are changing color. Moreover, the rural environment tends to be sparsely populated and motionless. For these reasons, avoiding detection in the rural environment usually requires stealth, using distance as cover, and adherence to strict principles of camouflage and concealment.

A long-range daytime and nighttime telephoto photography capability provides the standoff distance needed for safety of personnel, security of the operation, and it increases vantage point possibilities. Therefore, maximizing long-range photographic capability is important, but that requires addressing numerous variables. Variables exist and present challenges when using high-magnification for ultra-long-range photography. Variables become especially challenging during ultra-long-range photography using an image intensifier night vision device (NVD). For the latter, personnel must receive suitable training.

Attesting to the need for a long-range photographic capability is an excerpt from the United States Army Field Manual FM 31-20-5 (1993, March 23, p. 3-21), *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces.* The manual reports that, "Use of visual observation aids (binoculars, scopes, cameras) and thermal or infrared devices increase the SFOD's [Special Forces Operational Detachment] standoff distance and lessens the risk of compromise. Poor weather or heavy vegetation may require the SFOD to use multiple sites to achieve constant observation." What the excerpt reports applies whether the clandestine photography team represents the military, intelligence agencies, or law enforcement.

To be usable, a photographic image must provide essential detail such as subject identification (i.e., facial recognition) and legible vehicle number plates. The distance from which a telephoto lens or telescope can record such detail is the measure of the lens's effective range.

Short- and moderate-range manual clandestine photography tends to be forgiving of insubordination relative to methodology and optical system selection and application. The surveillance specialist is, in most instances, using off-the-shelf photographic equipment to record photographic images in the usual manner. The challenge is maintaining secrecy of the operation and avoiding detection while photographing the subject.

Long-range manual clandestine photography requires using super telephoto lenses, often with a tele-converter. Alternatively, the surveillance specialist can use a refracting telescope for photography by means of direct coupling (prime focus), with a tele-converter if necessary. Ultra-long-range manual clandestine photography requires using a high-magnification Schmidt-Cassegrain telescope (SCT) by means of direct coupling (prime focus), eyepiece projection, or the afocal method.

Significantly, as discussed and illustrated in Chapter 2 under the subheading *Tele-Converter Modification for Telescopes,* auto-focus tele-converters work with refracting telescopes and with Schmidt-Cassegrain telescopes (SCTs) after modification. All one must do is remove the electrical contacts and the electrical harness so they function as a manual tele-converter. To avoid modifying an expensive auto-focus tele-converter, some photographers place thin nonconductive tape on the electrical contacts to interrupt the electrical circuit.

When engaged in long-range and ultra-long-range photography, the surveillance specialist has the benefit of distance providing cover, previously stated. Unfortunately, numerous variables such as atmosphere and near ground thermals become a challenge. The deleterious affects of the variables increase as camera-to-subject distance increases. Long-range and especially ultra-long-range photography is unforgiving of insubordination relative to methodology and optical system selection.

Most field agents with comparatively limited training can do quality short- and intermediate-range manual clandestine photography under nonchallenging lighting conditions. Conversely, low-light photography, extreme distance photography, and photography using an image intensifier night vision device require a high level of technical expertise. Advanced technical expertise is especially necessary when employing hybrid methods such as during ultra-long-range night vision photography.

Urban Long-Range Manual Clandestine Photography

Although it is the rural environment usually demanding a long-range and ultra-long-range photographic capability, some manual clandestine photography in the urban environment falls within these classifications (see Figure 4-17).

Figure 4-17. *Camera-to-subject distance:* 548.64 meters 600 yards). The lower image is a cropped portion of the upper image. The surveillance specialist recorded this image from the eleventh story of a high-rise building. Photographing from that location provided excellent cover, an unobstructed view of the subject area, and it placed the camera above image degrading near-ground thermals. *Method:* Camera in mirror lock-up mode and operated using a remote shutter release. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 600mm f/4L IS USM super telephoto lens with a 2x tele-converter. *Effective focal length and f-ratio:* 1200mm f/8. *ISO:* 160. *Shutter speed:* 1/250 second. *Atmosphere:* Clear day.

When using a conventional camcorder for long-range manual clandestine videography, using the afocal coupling method is necessary (i.e., photographing through a telescope eyepiece). Later discussion addresses this.

Rural Ultra-Long-Range Clandestine Photography

For ultra-long-range manual clandestine photography, extreme focal length and large aperture are necessary. A long focal length provides high magnification and the diameter of the telescope determines light gathering ability and resolving power.

The surveillance specialist can record legible vehicle number plates from a greater distance than recording recognizable images of people's faces is possible. This is true whether photographing during daylight hours, under low-light conditions using high ISO and available light, or photographing at night using an image intensifier night vision device. This is because vehicle number plates feature high contrast while the human face features low contrast.

Ultra-high-magnification lenses permit the surveillance specialist to record detail such as subject identification (i.e., facial recognition) and legible vehicle number plates from distances that most people are unaware is possible. The ability to photograph from distances that are, to most people, unimaginable permits using distance as cover (refer ahead to Figure 4-26).

In many instances, observer-to-subject distance exceeds the capability of the strongest conventional telephoto lens, even when used with a 2x tele-converter. The strongest telephoto lens provided by Nikon is only 600mm and Canon's strongest telephoto lens is only 800mm. When used with a 2x tele-converter the 600mm lens is effective to a distance of approximately 0.60 kilometer (0.37 mile) and the 800mm lens with a 2x tele-converter is effective to approximately 0.80 kilometer (0.50 mile). Beyond such distances, the surveillance specialist uses a Schmidt-Cassegrain telescope (SCT) in the same manner he or she uses a telephoto lens. That is, the specialist uses the SCT by means of direct coupling (prime focus). Direct coupling results in the telescope actually becoming the lens of the camera (see Figure 4-18).

The rural environment typically features extreme observer-to-subject distances and that in turn requires an ultra-long-range photographic capability. The surveillance specialist must be capable of recording photographic images from distances of 0.80–1.61 kilometers (0.50–1 mile) and sometimes more. To be useful, the images must provide detail such as subject identification (i.e., facial recognition) and legible vehicle number plates. Photography from these distances requires using exceptionally high-magnifica-

Figure 4-18. The direct coupling (prime focus) method results in the Schmidt-Cassegrain telescope (SCT) actually becoming the lens of the camera. Direct coupling requires screwing a T-Adapter to the telescope, screwing a T-Ring to the T-Adapter, and then mounting the camera to the T-Ring. In the exploded view (lower image) the T-Adapter and T-Ring are already screwed together. This lens is the 1250mm f/10 Celestron C5 Spotting Scope, actually a small Schmidt-Cassegrain telescope.

tion optical systems whether recording single-image photographs or moving video images.

Attesting to the need for a long-range rural photographic capability is the United States Army Field Manual FM 2-0, *Intelligence* (2004, May 17, p. 6-9), an excerpt from which reads:

> In some cases HUMINT [human intelligence] teams require a standoff high resolution optical surveillance and recording capability that can provide target identification at extended ranges to protect the intelligence collector while avoiding detection by the adversary target. An advanced optical capability provides intelligence collectors the ability to locate and track adversarial targets (passive and hostile) for identification, collection, and target exploitations.

Atmospheric conditions more than the laws of optics determine the maximum distance from which the surveillance specialist can record usable photographic images. Indeed, for manual clandestine photography, modern optical systems have the ability to reach beyond what atmospheric conditions

usually permit. Although atmosphere is a limiting factor when practicing ultra-long-range photography, methods exist to manage atmospheric detriments. Chapter 7, *Atmosphere, Weather, and Manual Clandestine Photography,* discusses atmospheric issues and explains how to manage them to extend working distances and to maximize the quality of photographic images.

The ultra-long-range images provided in this section are good examples because the surveillance specialist recorded some of the images under unfavorable atmospheric conditions. When writing this book, the authors avoided selecting photographs recorded under ideal conditions. Rather, they saw value to providing images recorded under "typical" field conditions (i.e., good, average, and poor atmospheric conditions). The reader needs to see what surveillance specialists can record during real-life day-to-day photography operations wherein the subject, not the specialist, determines the time and location of photography.

Ultra-long-range manual clandestine photography, previously stated, requires using exceptionally high-magnification optical systems. Schmidt-Cassegrain telescopes (SCTs) are the usual choice (see Figures 4-19 to 4-21).

> *Warning!* When using a GPS controlled fork-mounted telescope, experiment to become familiar with the GPS feature before attaching a camera. If with a camera attached the telescope automatically begins searching for a specific overhead celestial object serious damage can result because the camera will not clear the bottom of the fork mount.

When photographing with a telescope during daylight hours using the direct coupling (prime focus) photography method, the telescope performs as a telephoto lens. Additionally, focal length and f-ratio (aperture) remain unchanged. For example, the 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT) and its successor the 12″ LX90-SC performs as a 3048mm f/10 telephoto lens when used in this manner. Significantly, using a Canon or Nikon tele-converter to increase the effective focal length of refracting telescopes and Schmidt-Cassegrain telescopes (SCTs) is possible (refer to Figures 2-20 and 2-21 in Chapter 2).

Do not permit the size and weight of large Schmidt-Cassegrain telescopes (SCTs) to be intimidating–amateur astronomers use them on a regular basis. For a two-person team, setup time for the 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope from the case to tripod mounted is only two minutes. After that, one simply mounts the camera and plugs in the hand control that permits operating the functions of the telescope such as

Figure 4-19. Using the direct coupling (prime focus) method, the surveillance specialist is in the process of photographing the property appearing in the next illustration. This 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT) records subject identification (i.e., facial recognition) and legible vehicle number plates from 1.61 kilometers (1 mile) and more depending on atmospheric conditions and method used. The specialist is using the digital single-lens reflex camera in the mirror lock-up mode and operating the it using a remote release (upper image, left hand). The hand control just left of the specialist's hand in the upper image permits operating the vertical and horizontal movement of the telescope. When using this telescope for photography, extreme camera-to-subject distance provides good cover although sometimes placing an antireflection device on the front of the lens tube is necessary, especially in sparsely populated rural areas (refer to Figure 3-30 in Chapter 3). In this and the next illustration, observe the denseness of the atmosphere. Heavy rain and tornados were imminent. The horizontal angle-of-view of this telescope is only 0° 41′ when used with a full-frame DSLR camera for prime focus photography. When used for daytime or night-vision afocal photography angle-of-view is greater or less depending on the focal length of the telescope eyepiece relative to the focal length of the lens viewing through the eyepiece.

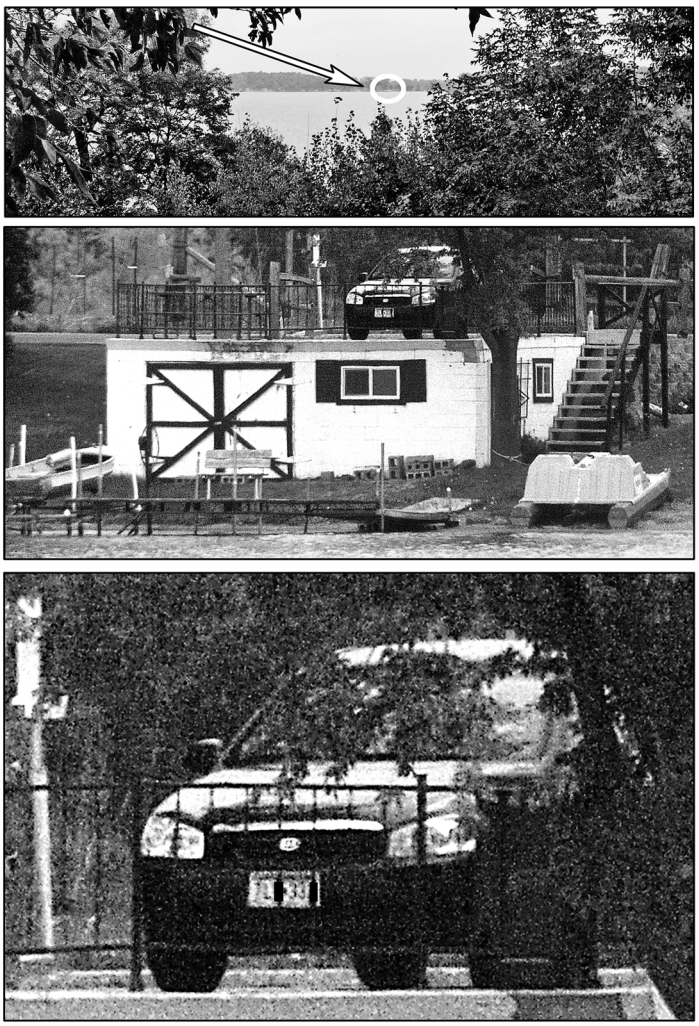

Figure 4-20. *Camera-to-subject distance:* 1.79 kilometers (1.11 miles). Even under poor atmospheric conditions, recording detail such as a vehicle number plate is sometimes possible from considerable distances. The white circle in the upper image identifies the subject location. The top overview image cropped top and bottom, sides not cropped. The center image is cropped top only. The lower image is a cropped portion of the center image. The surveillance specialist centered the vehicle in the frame to maximize clarity of the number plate. Schmidt-Cassegrain telescopes (SCTs) feature some curvature of field so centering important subject matter is helpful. This is a semirural environment. *Method:* Direct coupling (prime focus) photography. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT), 3048mm f/10. *ISO:* 250. *F-ratio (aperture):* f/10. *Shutter speed:* 1/500 second. *Atmosphere:* Poor–very thick, heavy rain and tornados were imminent. Note the absence of shadows in the center image.

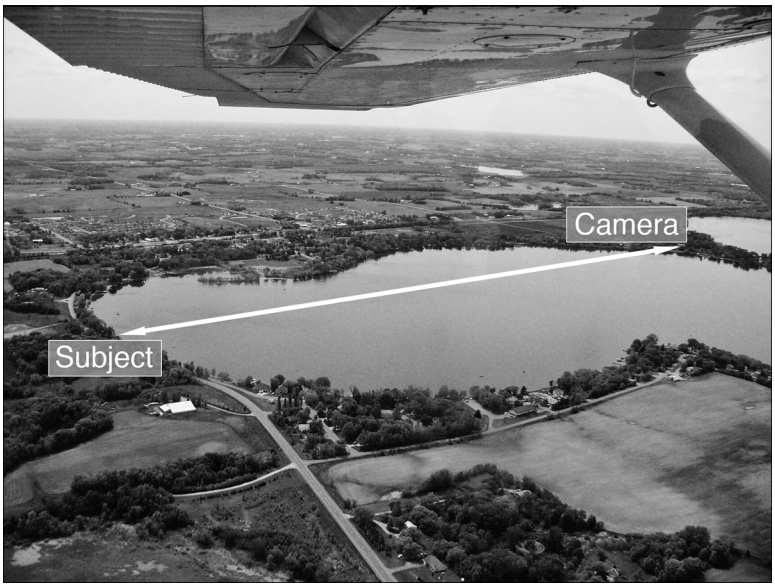

Figure 4-21. The line ends identify the camera and subject locations relative to the previous two illustrations. During the flyover, one of the authors recorded this image through the rear side window of the aircraft, recording this image as a backup and to illustrate that photographing through an aircraft window can yield usable results.

vertical and horizontal movement. One person can handle smaller SCTs such as the Celestron C11, and smaller. The C11 measures only 609.6 millimeters (24 inches) long and weighs only 12.47 kilograms (27.5 pounds). Larger telescopes, 304.8 millimeters (12 inches) and larger, are best managed by a two-person team for setup and takedown.

Schmidt-Cassegrain telescopes (SCTs) provide the surveillance specialist with exceptional telephoto capability for the recording of still images and moving video images. That is, within limitations imposed by the atmosphere, level of illumination, and the laws of optics. No matter how favorable field circumstances are, a telescope cannot record detail that is smaller than its resolution capability permits.

Direct coupling (prime focus) photography using a Schmidt-Cassegrain telescope (SCT) will not challenge the resolution capability of a large SCT. This is true even when using a Canon or Nikon tele-converter to increase magnification. Conversely, afocal photography and eyepiece projection photography can produce magnification sufficient to challenge the resolution of the SCT but in practice, the clandestine photographer does not encounter that situation. That is because the surveillance specialist does not need magnification sufficient to challenge the resolution of the telescope. Clandestine

photography is, after all, terrestrial photography.[6] By using progressively shorter telescope eyepieces during afocal and eyepiece projection photography, one can achieve increasingly greater degrees of magnification. There reaches a point, however, where magnification increases but resolution does not increase. Astronomers encounter this situation because they commonly use extreme magnification. Clandestine photographers doing terrestrial photography do not encounter this situation; what is high magnification to a terrestrial photographer is low to moderate magnification to an astronomer.

The epigraph at the beginning of this section stated that, for ultra-long-range manual clandestine photography, extreme focal length and large aperture are necessary. A long focal length provides high magnification and the diameter of the telescope determines light gathering ability and resolving power.

In astronomy, the rule-of-thumb is no more than 60x magnification per inch of telescope aperture (diameter). This rule-of-thumb suggests that the maximum magnification capability of the Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) is 555x (9.25 x 60 = 555). Similarly, the maximum magnification capability of the 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT) and its successor the 12″ LX90-SC telescope is 720x (12 x 60 = 720). Using a shorter focal length eyepiece to increase magnification beyond those limits will result in greater magnification but no increase of resolution (i.e., no increase of image detail). The greatest magnification featured in this book using the 3048mm f/10 12″ Meade LX90GPS SCT is nowhere near that SCTs magnification capability of 720x.

No matter how good atmospheric and other conditions are, a telescope cannot resolve objects smaller than the resolution of the telescope measured in arc-seconds. Relative to the figures in the previous paragraph, it is interesting to note that 555x magnification is equal to a 27,750mm telephoto lens and 720x magnification is equal to a 36,000mm telephoto lens when used with a full-frame DSLR camera. The surveillance specialist doing terrestrial photography will not use magnifications approaching the resolution capability of large Schmidt-Cassegrain telescopes (SCTs).

Previously stated, atmospheric conditions more than optical limitations determine the maximum distance from which the surveillance specialist can record usable photographic images. That being the case, high-magnification Schmidt-Cassegrain telescopes (SCTs) enable the surveillance specialist to record photographic images from as far as atmospheric conditions permit (see Figures 4-22 to 4-26).

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6. In addition to direct coupling (prime focus) photography and afocal photography, astronomers also practice eyepiece projection photography, which in some instances is a useful method for ultra-high-magnification clandestine photography (refer ahead to Figure 4-38).

Figure 4-22. *Camera-to-subject distance:* 0.40 kilometer (0.25 mile). The lower image is a cropped portion of the uncropped upper image. *Method:* Direct coupling (prime focus) photography. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* 3048mm f/10 12″ Meade LX90PGS Schmidt-Cassegrain telescope (SCT). *ISO:* 320. *F-ratio (aperture):* f/10. *Shutter speed:* 1/320 second. *Atmosphere:* Aside from moderate wind, atmospheric conditions were good. In some instances, one specialist uses high magnification to record detail while a second specialist records wider view images. Moreover, a third specialist can record moving video images. Observe the slight vignetting in the corners of the upper image that occurs when using a full-frame digital single-lens reflex camera with an SCT. *Important:* The magnification of this telescope is too great for this short distance unless photographing stationary subject matter or photographing human activity occurring within a limited area, and fine detail is required. The boat being mobile passes through the field-of-view very quickly! Applying an f/6.3 focal-reducer to the SCT would reduce magnification by 37 percent and increase the field-of-view by 63 percent (refer to Figure 2-26 in Chapter 2 and Figure 5-24 in Chapter 5). An f/6.3 focal-reducer on this SCT reduces focal length from 3048mm to 1920mm, and it increases f-ratio from f/10 to f/6.3. Use a focal-reducer when magnification of an SCT is too great for the circumstances (refer to Figure 2-27 in Chapter 2).

Figure 4-23. *Camera-to-subject distance:* 1.21 kilometers (0.75 mile). The lower image is a cropped portion of the upper right image. The upper left image is an overview with the white circle identifying the approximate boat location. *Method:* Direct coupling (prime focus) photography. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). *ISO:* 320. *F-ratio (aperture):* f/10. *Shutter speed:* 1/320 second. *Atmosphere:* Aside from moderate wind, atmospheric conditions were good. Camera-to-subject distance in this and the previous and next illustration is exact–in the passenger's left hand is the GPS receiver used to ensure distance accuracy. *Note:* It appears that the boat occupants are looking at the camera but from this extreme distance, they cannot see the surveillance specialist with unaided vision. Moreover, foliage obscures a view of the specialist. They are simply looking in the direction of the camera. People new to surveillance, when using a binocular or spotting scope to observe a distant subject sometimes become uncomfortable when it "appears" that the subject is looking at them. Remember, when using high magnification optics to observe a distant subject, the subject cannot see you with unaided vision. The subject is not looking at you–he or she is simply looking in your direction. In this illustration, the subjects in the boat are 1.21 kilometers (0.75 mile) from the camera, which is beyond the range of unaided vision.

For distances of 1.61 kilometers (1 mile) and more, consider using a manual 1.4x tele-converter with a large Schmidt-Cassegrain telescope (SCT) to increase magnification (refer to Figure 2-21 in Chapter 2). Alternatively, use a telescope featuring greater magnification, which is the better solution.

Some situations require locating a vantage point for long-term use. For example, investigating organized crime and gangs can require long-term static surveillance from an apartment, condominium, or office space in a high-rise building. In a rural or semirural area, working clandestinely from a remote outdoor site may be necessary. In other instances, obtaining permission

Figure 4-24. *Camera-to-subject distance:* 1.61 kilometers (1 mile). Overview image cropped top and bottom only, the white circle identifying the approximate subject location. The lower image is a cropped portion of the upper right image. *Method:* Direct coupling (prime focus) photography. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). *ISO:* 100. *F-ratio (aperture):* f/10. *Shutter speed:* 1/160 second. *Atmosphere:* Aside from moderate wind, atmospheric conditions were good. With unaided vision, the surveillance specialist was unable to detect the presence of the boat.

4-25. Aerial photograph showing the camera location and approximate boat positions in the previous two illustrations.

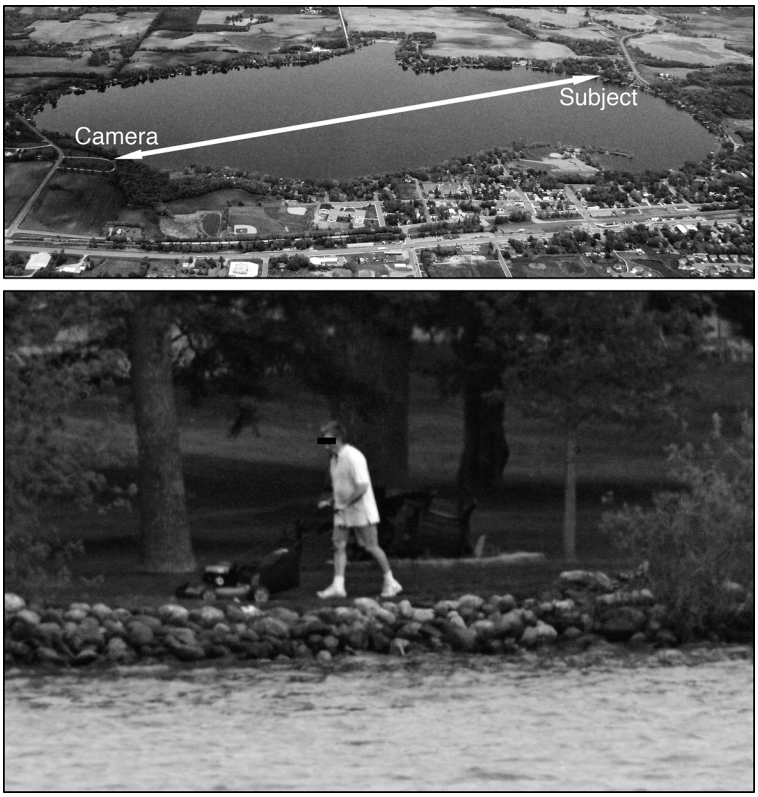

Figure 4-26. *Camera-to-subject distance:* 1.61 kilometers (1 mile). *Method:* Direct coupling (prime focus) photography. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). *ISO:* 400. *F-ratio (aperture):* f/10. *Shutter speed:* 1/90 second. *Atmosphere:* Poor—heavily overcast day resulted in subdued illumination and low contrast images.

to work from somebody's private property may be required. Fortunately, high-magnification optical systems permit photographing from extreme distances, which increases vantage point possibilities and reduces the likelihood of discovery by the subject.

Long-term extreme distance photography with or without an image intensifier night vision device requires using a Schmidt-Cassegrain telescope. Large SCTs feature bulk and weight but stated earlier, no need exists to fear them. Two people can easily handle a large SCT and transporting them and supplemental apparatus into high-rise buildings is quick and easy using a luggage platform truck. Bellman carts, luggage carts, and platform trucks attract no attention in a high-rise residential or office building because they are common in such environments. Filmtools® sells a variety of equipment carts suitable for photographers and videographers (www.filmtools.com).

Transporting large telescopes to remote rural sites is more challenging but possible. Construct a specialized backpack for the SCT. For rural surveillance, when circumstances permit, consider using a heavy-duty tree mount instead of a heavy-duty tripod. The tree mount is small, lightweight, and offers greater stability than a heavy-duty tripod (refer to Figure 3-19 in Chapter 3).

USE ADEQUATE FOCAL LENGTH

> Can a clandestine photography team record usable nighttime images of an extremist group's training base from a distance of 1.61 kilometers (1 mile) using an image intensifier night vision device? That is, can they record detail such as recognizable images of people and legible vehicle number plates? Experience and mathematical computations suggest that it may be possible under the right conditions, using a couple of different night vision photography methods. Magnification to accomplish it is attainable so whether it is achievable depends on field circumstances and atmospheric conditions. As distance increases, however, challenges increase. Refer to the Preface in Chapter 5.

Atmospheric conditions more than optical limitations determine maximum camera-to-subject distance, previously stated. Nevertheless, the optical system must be capable of the distance involved. Ultra-long-range clandestine photography requires using high-magnification Schmidt-Cassegrain telescopes (SCTs) because conventional telephoto lenses lack the necessary magnification. By means of direct coupling (prime focus) photography, the authors recorded several of the previous images.

Photographing with an SCT is necessary for distances of about 0.64 kilometer (0.40 mile) or more. The Canon and Nikon 600mm f/4 super telephoto lenses, even when used with a 2x tele-converter, struggle at a distance of 0.80-kilometer (0.5 mile) making use of an SCT necessary. The Canon 800mm f/5.6L IS USM super telephoto lens with a 2x tele-converter is adequate for a distance as great as 0.80 kilometer (0.50 mile), but no farther.

This section provides comparative images to illustrate the importance of using adequate focal length for extreme distance clandestine photography. To record the comparative images, the authors used the Canon EF 600mm f/4L IS USM super telephoto lens with the Canon EF 2x II tele-converter, and the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) by means of direct coupling. Photographic images better than words demonstrate the importance of using a focal length suitable for the distance involved (see Figures 4-27 to 4-31).

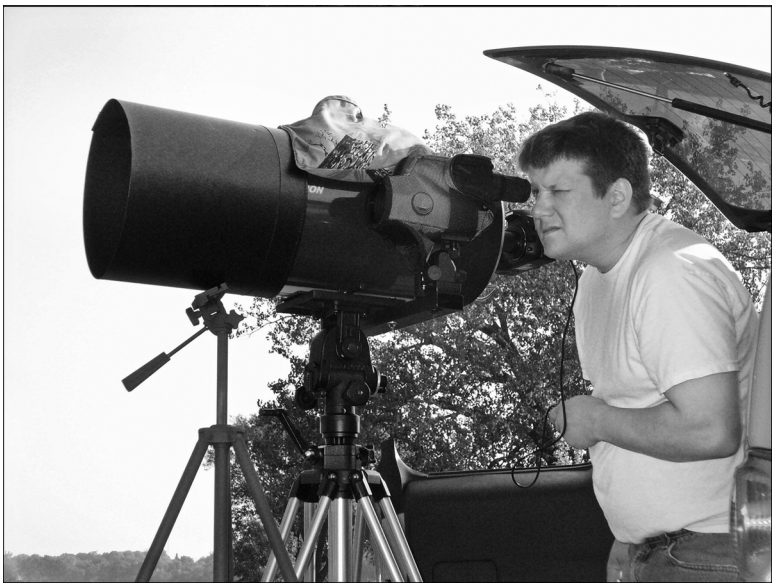

Figure 4-27. The surveillance specialist is using the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) as a telephoto lens by means of the direct coupling (prime focus) method. Mounting the telescope and Leupold 12-40x60 Tactical Spotting Scope side-by-side provides two benefits. First, the spotting scope serves as a crosshair finder scope. Second, the surveillance specialist can observe the subject through the spotting scope while using the camera in the mirror lock-up mode and operating it by means of a remote shutter release. The mirror lock-up mode prevents the action of the camera mirror causing vibrations when taking pictures. The spotting scope also provides a superior view of the subject. This telescope provides 47x magnification when used as a telephoto lens by means of the direct coupling method. By comparison, the Canon and Nikon 600mm telephoto lenses when used with a 2x tele-converter provide only 24x magnification. When using a second tripod to support the front of the lens to maximize stability place it into position after achieving proper framing of the subject. The sandbag on the lens stabilizes it against vibration and wind. Schmidt-Cassegrain telescopes (SCTs) are so lightweight that wind tends to cause unwanted movement. Observe that the specialist is using the vehicle as a windbreak. Supporting the telescope is the Majestic #1001 3/8″ Screw Mount Gearhead with 6″ x 7″ Camera Platform, this head featuring a load capacity of 15.88 kilograms (35 pounds). Surveillance specialists often photograph without camouflage because the nature of the vantage point and the camera-to-subject distance leaves camouflage unnecessary. In some instances, camouflage will contradict the nature of a pretext. A curious person living in a nearby house once asked a surveillance specialist what he was doing, the person being curious about the camera adapted Schmidt-Cassegrain telescope (SCT). The specialist explained that he was familiarizing himself with a newly acquired telescope and camera to do wildlife photography. He further explained that he needed to determine how the camera and telescope performed under various levels of light and sun direction, and determine at what point it was too dark to record good pictures of animals. That explanation justified being in the area for the duration of the day. Satisfied with that explanation the person went about their business.

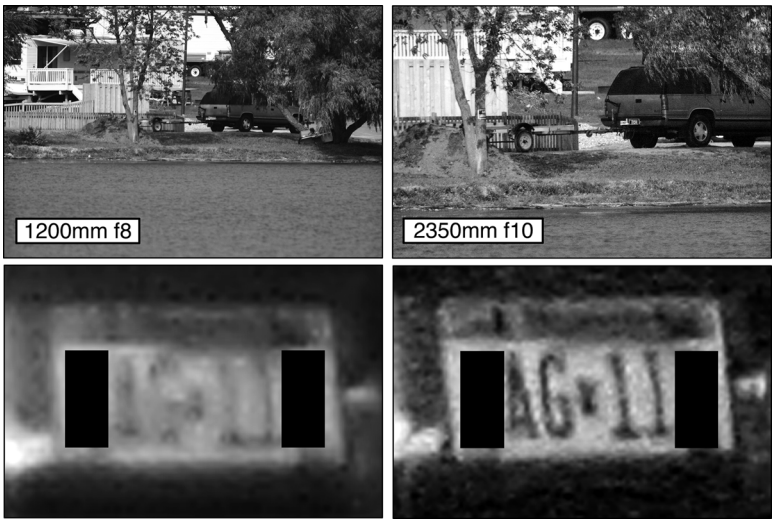

Figure 4-28. *Camera-to-subject distance:* 0.89 kilometer (0.55 mile). The surveillance specialist used a telephoto lens and then a telescope to record these comparative images. When distance exceeds the magnification capability of a super telephoto lens, use a Schmidt-Cassegrain telescope (SCT). *Left images:* Image recorded using the Canon EOS 30D digital single-lens reflex crop-sensor camera with the Canon EF 600mm f/4L IS USM super telephoto lens and Canon EF 2x II tele-converter. Effective focal length and f-ratio (aperture) is 1200mm f/8. Lower image is a cropped portion of the upper image. *Right images:* Image recorded using the same camera with the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT). Lower image is a cropped portion of the upper image.

> Do not feel the need to replace an old camera just because a newer model became available. As long as the existing camera serves its intended purpose, continue using it. When purchasing a new camera, keep the old one as a backup or use them both. Use an older camera when anticipating harsh field conditions. Introduction of a new camera model does not automatically render its predecessor obsolete.

In this book, the reader observes the authors using the Canon EOS 30D, 5D, 5D Mark II, and EOS-1D Mark IV digital single-lens reflex (DSLR) cameras. Long ago Canon discontinued making the crop-sensor EOS 30D DSLR camera, yet the authors continue to use it even though they have more sophisticated late model Canon DSLR cameras. For those who wonder why the authors continue to use the discontinued EOS 30D crop-sensor camera, the answer is simply that it performs well–no reason exists to discontinue using it. Consider what astronomer Andy Munro explains about the 30D crop-sensor DSLR camera relative to full-frame DSLR cameras in

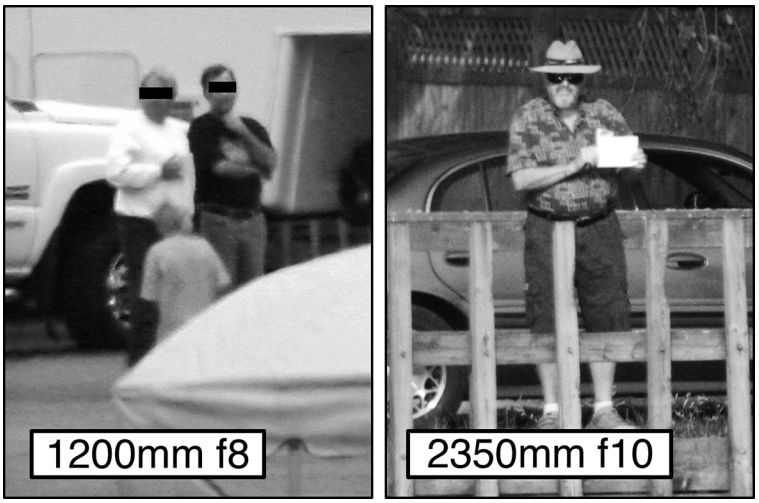

Figure 4-29. *Camera-to-subject distance of the individual:* 0.89 kilometer (0.55 mile). The three individuals in the left image are slightly farther from the camera. The surveillance specialist used a telephoto lens and then a telescope to record these comparative images, these images being a cropped portion of the images in the next illustration. *Left image:* Image recorded using the Canon EOS 30D digital single-lens reflex crop-sensor camera with the Canon EF 600mm f/4L IS USM super telephoto lens and Canon EF 2x II teleconverter. Effective focal length and f-ratio (aperture) is 1200mm f/8. ISO 100, exposure time 1/125th second. *Right image:* Image recorded using the same camera with the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT). Method was prime focus (direct coupling) photography. ISO 800, f-ratio (aperture) f/10, exposure time 1/1500 second.

terms of comparative pixel size and image detail. What Mr. Munro explains also illustrates the potential complexity of ultra-long-range manual clandestine photography when combining terrestrial and astrophotography methods. Mr. Munro explains that:

> Most terrestrial photographers seem to think that larger pixels always lead to better images due to lower noise. However, the noise benefits of larger pixels are counterbalanced significantly when we push magnification and the resulting image scale, so there is a trade-off. What you are doing truly is a hybrid of astro and traditional terrestrial techniques. One easily manipulated setting that will reduce noise is the ISO speed you run the chip at: lower ISO should be lower noise.
>
> A quick lookup on the web indicates that the Canon EOS 5D has an 8.2 micron pixel size—while the Canon EOS 30D pixel size is 6.4 microns. With the same high-magnification lens, I would expect better detail potential

Figure 4-30. *Camera-to-subject distance of the individual:* 0.89 kilometer (0.55 mile). The people appearing in the previous illustration are cropped portions of these two images. As the next illustration shows the group of people were slightly farther from the camera than the individual was.

from the 30D, but with higher noise potential. It looks to me like the new 7D (18-megapixel sensor with 4.3-micron pixels) could be superior for high magnification using low ISO settings, if the chip is not too noisy.

In astro-CCD imaging we try to match a pixel to ~ 1/2 the diameter of a star image, so we actually calculate image scale for a telescope before selecting a sensor chip. You could do the same thing for surveillance work–plan

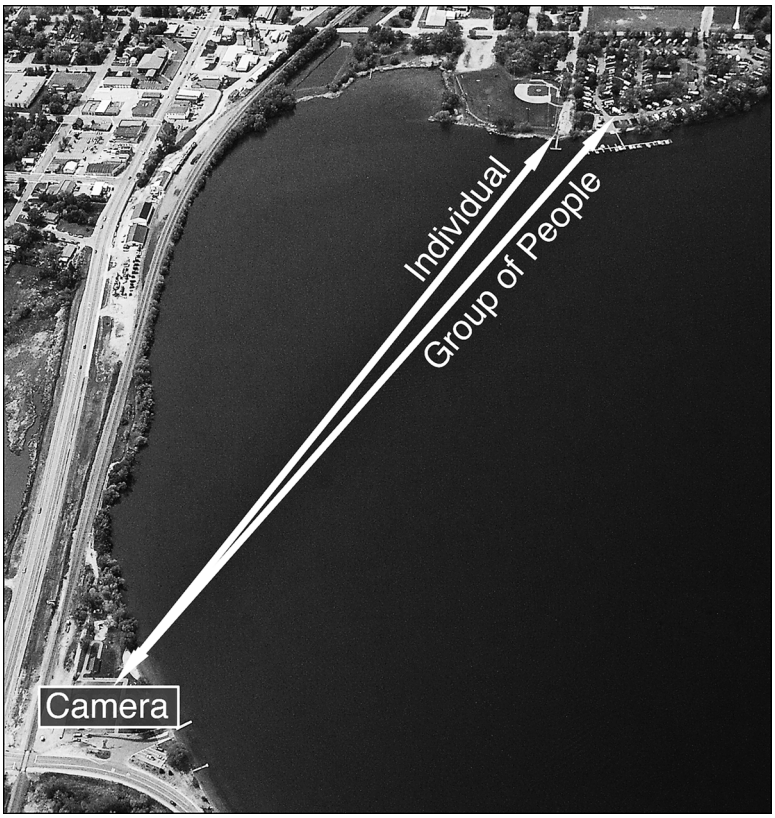

Figure 4-31. This aerial photograph identifies the camera and subject locations of the previous two illustrations.

> the "best" sensor given a desired level of magnification based on target distance - though in practice I don't know how much benefit there would be. . . . (Andy Munro, personal communication, December 2, 2009)

During ultra-long-range photography, the authors find they record slightly better image detail with the 8.2 megapixels crop-sensor Canon EOS 30D DSLR camera than they do with the 12.8 megapixels full-frame Canon EOS 5D DSLR camera. Maximizing ultra-long-range photographic capability requires addressing numerous variables including selecting a camera that performs best for that application.

Having discussed and illustrated ultra-long-range manual clandestine photography, a lingering question may exist for some readers. The question is to what level can one elevate the art? How technical and advanced can ultra-long-range photography become? Extreme distance manual clandes-

tine photography can be highly technical and advanced and the need for further research and development in this area exists, especially when bringing image enhancement night-vision technology into the equation. Reflect back to what Mr. Munro explained relative to the complex nature of astrophotography methods.

Can a clandestine photography team record usable nighttime images of an extremist group's training base from a distance of 1.609 kilometers (1 mile) using an image intensifier night vision device? That is, can they record detail such as recognizable images of people and legible vehicle number plates? Experience and mathematical computations suggest that it is possible under the right conditions, and that is can be done using more than one photographic method. Actually, greater distances are possible.

AFOCAL PHOTOGRAPHY AND VIDEOGRAPHY

> Afocal coupling is the placement of a camera with a lens at the eyepiece of a telescope for the purposes of taking a picture through the telescope. . . . It is generally not considered the best arrangement for imaging due to the large number of optical elements involved. However, with the high quality optics, very good to excellent results can be obtained. (Turberville, 2003, n.p.)

> Digital single-lens reflex cameras featuring a high-definition video capture mode permit ultra-long-range daytime and night vision videography without the need for afocal coupling although one can use them via the afocal coupling method.

The Method

Afocal photography by means of afocal coupling is simply taking pictures through a telescope eyepiece using a single-image camera, camcorder, or a camera or camcorder adapted night vision device (see Figure 4-32). Whether the telescope eyepiece is on a refracting telescope, Schmidt-Cassegrain telescope (SCT), or on a conventional telephoto lens is irrelevant. *Note:* For afocal photography refracting telescopes are problematic inasmuch as the eyepiece moves in/out during focusing.

There are several reasons why the surveillance specialist uses afocal coupling for the recording of single images or moving video images, day and night. Circumstances and need determine when afocal coupling is necessary with the following situations being the most common.

Figure 4-32. Afocal coupling, also referred to as afocal photography, is simply taking pictures through a telescope eyepiece using a single-image camera, camcorder, or camera adapted night vision device. The eyepiece may be on a Schmidt-Cassegrain telescope (SCT), as illustrated here, on a refracting telescope (refer ahead to Figure 4-36), on a spotting scope (refer ahead to Figure 4-37), or on a conventional telephoto lens (refer ahead to Figure 4-41, refer to Figure 5-36 in Chapter 5, and Footnote 10 in Chapter 5). Long-range and ultra-long-range videography and night vision photography and videography requires afocal coupling with one exception. The exception is, digital single-lens reflex cameras featuring a high-definition video capture mode permit ultra-long-range daytime and night vision videography without the need for afocal coupling although one can use them via the afocal coupling method. Illustrated here is the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) with a 26mm eyepiece and the Canon EOS 5D digital single-lens reflex camera with the Canon EF 50mm f/1.4 USM lens. This optical configuration provides an effective focal length and f-ratio of 4519mm f/12 (specifically 4519.05mm f/11.92).

- Afocal coupling provides the means to increase the effective f-ratio (speed) of a lens when low-light conditions require an exceptionally fast optical system (refer ahead to Figure 4-45 and refer to Figures 5-13 and 5-14 in Chapter 5). The surveillance specialist accomplishes that by using a telescope eyepiece featuring a focal length greater than the lens photographing through it (e.g., the lens on the camera or night vision device). For example, a 28mm f/2.8 lens on a digital single-lens reflex camera and a 40mm telescope eyepiece on a Canon or Nikon 600mm f/4 super telephoto lens results in an effective focal length and f-ratio of 420mm f/2.8.

- Afocal coupling provides the means to reduce effective focal length when necessary. *When using a Schmidt-Cassegrain telescope (SCT) by means of direct coupling (prime focus) an f/6.3 focal-reducer provides the means to reduce magnification and increase effective f-ratio.*
- Afocal coupling is required for long-range and ultra-long-range daytime videography unless using a digital single-lens reflex camera featuring high-definition video capture.
- Afocal coupling is required for long-range and ultra-long-range night vision videography. The exception is when using a digital single-lens reflex (DSLR) camera with the AstroScope™ Night Vision Module configured for use with Schmidt-Cassegrain telescopes (SCTs). Nevertheless, afocal coupling is necessary when camera-to-subject distance exceeds the magnification provided by the telescope when used via the direct coupling (prime focus) method.
- The longest focal length lens is inadequate for the camera-to-subject distance. Afocal coupling permits increasing magnification.
- High magnification is necessary but circumstances do not permit transporting the size and weight of the appropriate focal length lens to the vantage point. The surveillance specialist takes a smaller lens into the field and increases magnification by means of afocal coupling (see Figures 4-33 to 4-35 and refer ahead to Figure 4-47).

Afocal coupling results in an increase, decrease, or no change to the effective focal length and f-ratio[7] of a telephoto lens or telescope. The following three factors determine the effective focal length and f-ratio of the

- Focal length and f-ratio (aperture) of the host lens (telephoto lens or telescope).
- Focal length of the telescope eyepiece.
- Focal length of the lens on the camera. If the maximum aperture of the camera lens is smaller than the f-ratio of the overall optical system, the aperture of the camera lens prevails.

Afocal coupling, previously stated, results in an increase, decrease, or no change to focal length and f-ratio (refer back to Figures 4-34 and refer ahead to Figure 4-45). The surveillance specialist recorded both images using the

7. Photographers speak of aperture because it is the only aperture-related adjustment on a camera or camcorder lens. When practicing afocal photography, the relationship between the focal length of the telescope eyepiece and the focal length of the lens on the camera does not increase or decrease aperture. What it does is increase or decrease the f-ratio, f-ratio being focal length divided by aperture.

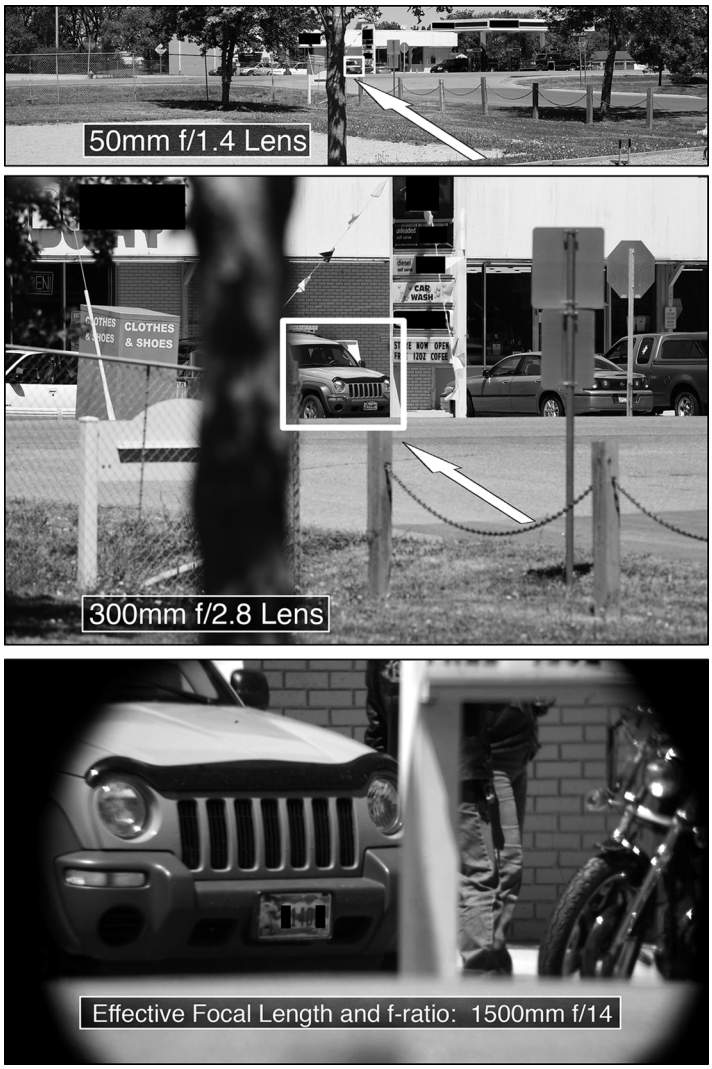

Figure 4-33. In this instance, afocal coupling provides high magnification in a small package. Here, afocal coupling increased the Canon 300mm f/2.8 telephoto lens to 1500mm f/14. On a digital single-lens reflex (DSLR) camera, a 300mm lens provides 6x magnification. In this instance, by means of afocal coupling the 300mm lens provides 30x magnification. *Camera-to-subject distance:* 115.21 meters (126 yards). *Upper image:* Overview of the scene with the white square identifying the subject vehicle. Image cropped top and bottom only. *Center image:* Uncropped view recorded using a Canon 300mm f/2.8 telephoto lens. *Lower image:* Vehicle photographed using the Canon 300mm f/2.8 telephoto lens fitted with a 10mm eyepiece and then photographed by means of afocal coupling. That optical configuration increased magnification five times. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera with a 50mm f/1.4 lens. *Telephoto lens:* Canon EF 300mm f/2.8L IS USM telephoto lens. *Eyepiece:* 10mm. *ISO:* 100. *Shutter speed:* 1/160 second. The lower image is cropped on all four sides to accommodate the format of this book page.

Figure 4-34. Daytime afocal photograph–4137mm f/28. *Camera-to-subject distance:* 0.549 kilometers (0.34 mile). The surveillance specialist used afocal coupling to increase the effective focal length of the Canon 600mm f/4 super telephoto lens to 4138mm f/28 (specifically 4137.60mm f/27.58). *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera with a 50mm f/1.4 lens. *Telephoto lens:* Canon EF 600mm f/4L IS USM telephoto lens with a 2x tele-converter. *Eyepiece:* 14.5mm. *ISO:* 1,000. *Shutter speed:* 1/125 second.

Canon EF 600mm f/4L IS USM telephoto lens via afocal coupling. One image shows the lens performing as a 4138mm f/28 optical system and the other image shows it performing as a 252mm f/1.8 optical system.

When using a digital single-lens reflex (DSLR) camera in the single-image or video capture mode, afocal coupling is an optional method. Afocal coupling is not an optional method, but a required method, for ultra-long-range videography using a camcorder. Afocal coupling is also necessary for long-range night vision photography and videography unless using the AstroScope Night Vision Module configured for use with Schmidt-Cassegrain telescopes and DSLR cameras.

Long-range and ultra-long-range videography using a camcorder featuring a permanently installed lens requires afocal coupling. Camcorders that do feature lens interchangeability have no super telephoto lenses available for them and neither do they allow for prime focus photography.

Afocal coupling with a single image camera or camcorder provides almost unlimited magnification potential, within the laws of optics. Terrestrial photographers seldom use afocal coupling but astro-photographers do use the method although more recently they have embraced tiny CCD cameras for narrow-field work. As applied to manual clandestine photography, afocal

Figure 4-35. Daytime afocal DSLR camera videography–117 meters (128 yards). This is a single frame (freeze-frame)[8] from a daytime video recorded using the high-definition video capture mode of the Canon EOS 5D Mark II digital single-lens reflex full-frame camera sporting a 50mm f/1.4 lens. The surveillance specialist placed a 1.4x tele-converter and a 25mm telescope eyepiece on the Canon EF 300mm f/2.8L IS USM telephoto lens and recorded moving video images through the eyepiece using the DSLR camera. That afocal optical configuration increased the effective focal length from 300mm to 840mm and reduced the f-ratio from f/2.8 to f/7.84. *ISO:* 250. *Shutter speed:* 1/40 second. The tripod-mounted camera was inside a second level condominium about 0.91 meters (3 feet) back from a partially open window. The interior of the condominium was dark–interior lights off. *Atmosphere:* Good. *Illumination:* Normal daytime ambient illumination.

coupling is a hybrid of astro and traditional terrestrial photography techniques.

LE-Adapter–Lens to Eyepiece Adapter

> Digiscoping is the process of taking photos with a digital camera, either still or video, through a spotting scope. (Optics4Birding.com, 2010, n.p., *Digiscoping*)

Bill Benz of Lens Adapter designed the LE-Adapter for afocal photography and videography using telescopes, spotting scopes, binoculars, telescopic rifle sights, handheld periscopes such as the Swatscope®, and night vision

8. Canon explains that, "When taking still images during a movie, video recording will be interrupted and "freeze" for about one second, and immediately resume after the still image is taken" (Canon U.S.A., Inc., 2010, n.p., *EOS 5D Mark II: Movie mode basics*). Case specific needs determine if the one-second interruption is objectionable–it can result in failure to capture essential moving images; it can result in failure to record a critical decisive moment.

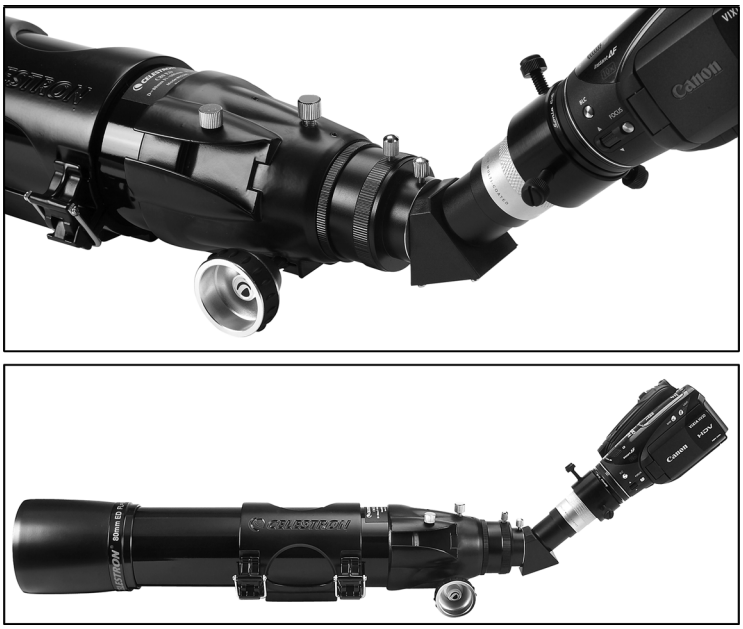

Figure 4-36. The LE-Adapter couples the 600mm f/7.5 Celestron 80ED refractor spotting scope (telescope) and Canon VIXIA HV30 high-definition consumer-grade camcorder. The 32mm telescope eyepiece with the camcorder's zoom lens set at 10mm results in an effective focal length and f-ratio of 188mm f/2.34. This is a good optical configuration for intermediate-range low-light videography. The 45-degree "correct-image prism diagonal" provides an upright nonreversed image on the camcorder LCD monitor; conventional prism diagonals provide an inverted image. When using a camcorder adapted night vision device (NVD), use a 90-degree correct-image prism diagonal to place apparatus weight over the eyepiece without applying undue leveraged force. *When using a telescope for terrestrial viewing, use a 45-degree or 90-degree correct-image prism diagonal to view an upright image.*

devices (see Figures 4-36 and 4-37). Setup is quick and easy. For comprehensive product information, visit the manufacturer's website (www.lens adapter.net).

Use a Sufficiently Large SCT

Afocal coupling for clandestine photography and videography begs further exploration to refine field application methods. Field personnel must know what optical configurations and techniques work best and what does not work so well if at all.

For extreme distance photography using afocal coupling or eyepiece projection, best results occur when using a larger Schmidt-Cassegrain telescope

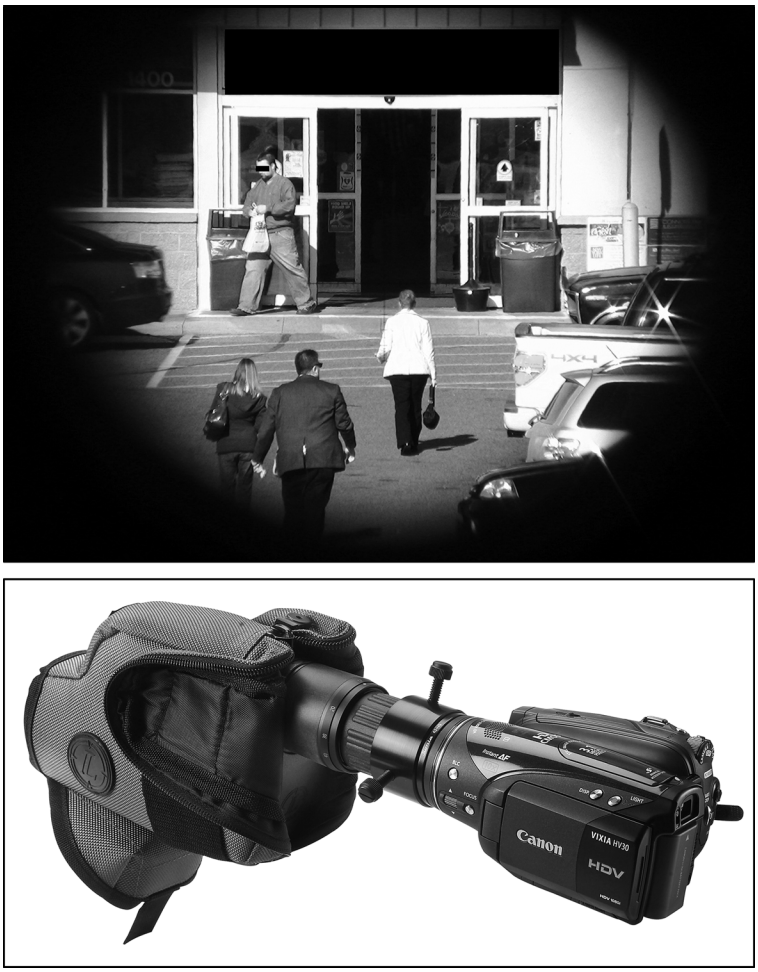

Figure 4-37. The LE-Adapter couples the Leupold 12-40x60 Tactical Spotting Scope and Canon VIXIA HV30 high-definition consumer-grade camcorder for what some photographers refer to as digiscoping. From 180 meters (197 yards), using the apparatus shown here, the surveillance specialist used the Photo Mode (freeze-frame) feature of the camcorder to record the people in the upper image. Using the spotting scope zoom feature for a close-up view decreases the diameter of the image circle, which reduces the field-of-view and increases vignetting, although good close-up detail results.

(SCT) rather than simply using increasingly shorter focal length eyepieces to increase magnification. Contemplate the following examples using a DSLR camera with a 50mm normal lens for daytime afocal photography:

- 24-millimeter telescope eyepiece on the 3048mm f/10 12″ Meade LX200-ACF telescope. Effective focal length and f-ratio 6350mm f/21.

- 32-millimeter telescope eyepiece on the 4064mm f/10 16″ Meade LX200-ACF telescope. Effective focal length and f-ratio 6350mm f/16.

Relative to the above example, the longer focal length eyepiece on the 16″ Meade LX200-ACF telescope results in the same magnification but image resolution is better by virtue of the larger telescope diameter. Additionally, although magnification is the same in each instance, the larger telescope provides an f-ratio that is greater by an amount offering slightly more than a 2/3-stop advantage, specifically 0.7846 stops. A 2/3-stop advantage is significant when lighting is poor, and it is beneficial during photography using an image intensifier night vision device.

Computing Effective Focal Length and F-Ratio

When using the afocal coupling method, determining the effective focal length and f-ratio (aperture) of the resultant optical system is quick and easy.

The Calculations

Previously stated, afocal coupling will increase, decrease, or cause no change to the effective focal length and f-ratio (aperture) of the optical system. The focal length of the telescope eyepiece and the focal length of the lens on the camera determines whether effective focal length and f-ratio changes and the extent of change.

Determining effective focal length and f-ratio is quick and easy. More than one formula exists to make the calculations, but the surveillance specialist needs only one formula for each. The following two formulas make calculating effective focal length and f-ratio quick and easy. The formulas apply whether using a single-image camera, camcorder, or camera adapted night vision device, and whether using a refractive or Schmidt-Cassegrain telescope or using a telephoto camera lens sporting a telescope eyepiece.

Determine the effective focal length and f-ratio of the optical system based on *Projection Magnification* by performing the following calculations:

- Determine *projection magnification* by dividing the focal length of the lens on the camera by the focal length of the telescope eyepiece. The quotient is the projection magnification.
- Multiply the focal length of the telescope or telephoto lens by the projection magnification. The product is the effective focal length of the entire optical system.
- Determine the effective f-ratio by multiplying the f-value of the telescope or telephoto lens by the projection magnification.

Example 1:

Determine effective focal length–multiply the focal length of the telescope by the projection magnification

- Digital single-lens reflex camera with a 50mm lens
- Telescope, 3048mm f/10 (12″ Meade Schmidt-Cassegrain telescope)
- 14.5mm eyepiece on the telescope

Projection magnification: 50 ÷ 14.5 = 3.448 (Projection magnification is 3.448)

Effective focal length: 3048 x 3.448 = 10,510 (Effective focal length is 10,510mm)

Determine effective f-ratio–multiply the telescope f-value by the projection magnification

- Telescope–f/10
- Projection magnification–3.448

Effective f-ratio: 10 x 3.448 = 34.48 (Effective f-ratio is f/34.48)

This optical system is the equivalent of a 10,510mm f/34 lens.

Example 2:

Determine effective focal length–multiply the focal length of the telephoto lens by the projection magnification

- Camcorder with the zoom lens set at 25 millimeters
- Telephoto lens 1200mm f/8 (600mm f/4 lens with a 2x tele-converter)
- 14.5mm eyepiece on the telephoto lens

Projection magnification: 25 ÷ 14.5 = 1.724 (Projection magnification is 1.724)

Effective focal length: 1200 x 1.724 = 2,068.90 (Effective focal length is 2,068.90mm)

Determine effective f-ratio–multiply the telephoto lens f-value by the projection magnification

- Telephoto lens f/8
- Projection magnification 1.724

Effective f-ratio: 8 x 1.724 = 13.79 (Effective f-ratio is f/13.79)

This optical system is the equivalent of a 2,069mm f/14 lens.

Example 3:

Determine effective focal length–multiply the focal length of the telephoto lens by the projection magnification

- Digital single-lens reflex camera with the Canon EF 24mm f/1.4L II USM lens
- Telephoto lens, 300mm f/2.8
- 50mm eyepiece on the telephoto lens

Projection magnification: 24 ÷ 50 = 0.48 (Projection magnification is 0.48)

Effective focal length: 300 x 0.48 = 144 (Effective focal length is 144mm)

Determine effective f-ratio–multiply the telephoto lens f-value by the projection magnification

- Telephoto lens–f/2.8
- Projection magnification–0.48

Effective f-ratio: 2.8 x 0.40 = 1.34 (Effective f-ratio is f/1.34). The camera lens maximum aperture of f/1.4 prevails so use that value, not f/1.34.

This optical system is the equivalent of a 144mm f/1.4 lens.

An Important Afocal Photography Variable

After computing the effective focal length of the optical system, one must apply the camera's focal length conversion factor if the camera is not a full-frame digital single-lens reflex camera. This applies also when using a camcorder or digital pocket camera.

Now understanding the computations discussed above, consider this variable. The above calculations accurately determine the effective focal length

of the optical system. No problem exists when using a full-frame digital single-lens reflex (DSLR) camera. A problem can exist when using a small image sensor camera such as a crop-sensor DSLR camera, digital pocket camera, or a camcorder. For small sensor cameras, one must apply the camera's focal length conversion factor, which pertains to 35mm equivalent focal length relative to angle-of-view and thus field-of-view. This is important because in some instances the magnification required to record essential detail leaves one with inadequate field-of-view when using a small image sensor camera.

Canon crop-sensor DSLR cameras feature a 1.3x or 1.6x focal length conversion factor depending on which image sensor the camera contains. Nikon crop-sensor DSLR cameras feature a 1.5x focal length conversion factor. The Canon VIXIA HV30 high-definition camcorder with the comparatively small 1/2.7″ CMOS Sensor features a focal length conversion factor of 7.15x. After computing the effective focal length of the optical system, one must apply the camera's focal length conversion factor if not using a full-frame DSLR camera. Applying the focal length conversion factor determines equivalent angle-of-view (not magnification).

The effective focal length of the optical system in Example 1 is 10,510mm. When used with a Canon crop-sensor DSLR camera featuring a 1.6x focal length conversion factor, the optical system angle-of-view is equivalent to a 16,816mm lens on a full-frame DSLR camera. When used with the Canon VIXIA HV30 camcorder featuring a 7.15x focal length conversion factor, the optical system angle-of-view is equivalent to a 75,147mm lens on a full-frame DSLR camera. Clearly, limited field-of-view can be a problem when using a small image sensor camera (or camcorder) with the afocal coupling method to increase magnification.[9]

When using the afocal coupling method with a small image sensor camera for ultra-long-range photography or videography, use only enough magnification to record essential detail. Using more magnification than needed unnecessarily diminishes the field-of-view. One may experiment with a zoom telescope eyepiece to find the degree of magnification that represents the ideal compromise between field-of-view and magnification. Celestron offers a 1.25″ 8-24mm focal length zoom eyepiece (Item #93230) that they

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9. When used with a full-frame digital single-lens reflex (DSLR) camera, the Canon 600mm f/4 super telephoto lens features a 3° 30' horizontal angle-of-view. When used with the Canon VIXIA HV30 camcorder featuring a 7.15x focal length conversion factor the angle-of-view diminishes to twenty-nine minutes twenty-six seconds (29′ 26″). *The 29′ 26″ angle-of-view applies when the focal length of the lens on the camera and the focal length of the telescope eyepiece are the same so that working together, they neither increase or decrease the magnification and f-ratio of the entire optical system. Using the zoom feature of the camcorder lens to increase and decrease focal length will increase and decrease angle-of-view and thus field-of-view.*

describe as follows: "Super-premium fully multi-coated 1.25″ zoom eyepiece has a focal length of 8-24mm. Allows for expanded magnification options." Not having used this eyepiece, the authors can offer no insight as to its performance for afocal clandestine photography and videography.

When using the afocal method with a camcorder, a large image sensor camcorder provides a wider field-of-view than a smaller sensor camcorder does.

EYEPIECE PROJECTION PHOTOGRAPHY

Schmidt-Cassegrain telescopes (SCTs) provide a high degree of magnification and therefore they are ideal for long-range and ultra-long-range manual clandestine photography. Nevertheless, extreme camera-to-subject distance sometimes requires a greater degree of magnification than the direct coupling (prime focus) photography method provides. In such instances, the surveillance specialist increases magnification by means of afocal photography or eyepiece projection photography.

Setting up for eyepiece projection photography is quicker, easier, and usually provides a higher quality image than afocal coupling does. Eyepiece projection photography requires using an eyepiece projection adapter, commonly called a tele-extender. Do not confuse this type of tele-extender with the conventional photographic tele-extender (tele-converter) offered by Canon and Nikon. They are two different products. Celestron (2010, n.p.) describes their Deluxe Tele-Extender as follows:

> The Deluxe Tele-Extender for Schmidt-Cassegrain telescopes is a hollow tube that allows you to attach a camera to your telescope, with an eyepiece installed. By using the Deluxe Tele-Extender in combination with an eyepiece, you can increase your instrument's effective focal length to well over 10,000mm! And this corresponds with a matching increase in image size. This technique is known as eyepiece projection photography.

Setup for eyepiece projection photography using a Schmidt-Cassegrain telescope (SCT) involves the following steps:

- Screw a visual back (eyepiece holder) to the rear cell of the Schmidt-Cassegrain telescope (SCT).
- Insert an eyepiece into the visual back and secure it in place.
- Place the eyepiece projection adapter (tele-extender) over the eyepiece and visual back and secure it in place.

- Screw a T-Ring to the tele-extender, a T-Ring that is compatible with the camera's lens mount.
- Remove the lens from the DSLR camera and then attach the camera to the T-Ring.

The eyepiece projection method permits the telescope eyepiece to project an image directly onto the camera's image sensor (see Figure 4-38).

Three factors determine the effective focal length of the optical system when using the eyepiece projection method. The three factors are the focal length of the telescope, focal length of the eyepiece, and the distance between the optical center of the eyepiece and the camera's image sensor.

When doing eyepiece projection photography, determine the approximate effective focal length by performing the following calculations:

- Divide the telescope focal length by the focal length of the eyepiece and note the quotient.
- Multiply the quotient by the distance between the camera's image sensor and the optical center of the telescope eyepiece. The product is the effective focal length of the entire optical system. Manufacturers of telescope eyepieces place no mark on the eyepieces to identify the optical center so, unfortunately, one must estimate.

Eyepiece projection photography presents no optical alignment challenge. The tele-extender aligns everything perfectly. The primary challenge for some surveillance specialists will be adapting to the inverted image, an image that is upside-down and reversed left to right. Once accustomed to working with an inverted image, it presents no problem.

Note: When using a Schmidt-Cassegrain telescope (SCT) for night vision photography, the eyepiece projection method *does not* work. When using an image intensifier night vision monocular with an SCT, afocal coupling is necessary. This is true also when using an SCT for long-range and ultra-long-range videography whether or not using the camcorder with a night vision device. When using the AstroScope Night Vision Module and DSLR camera with an SCT by means of direct coupling, the image is upright and correct left to right.

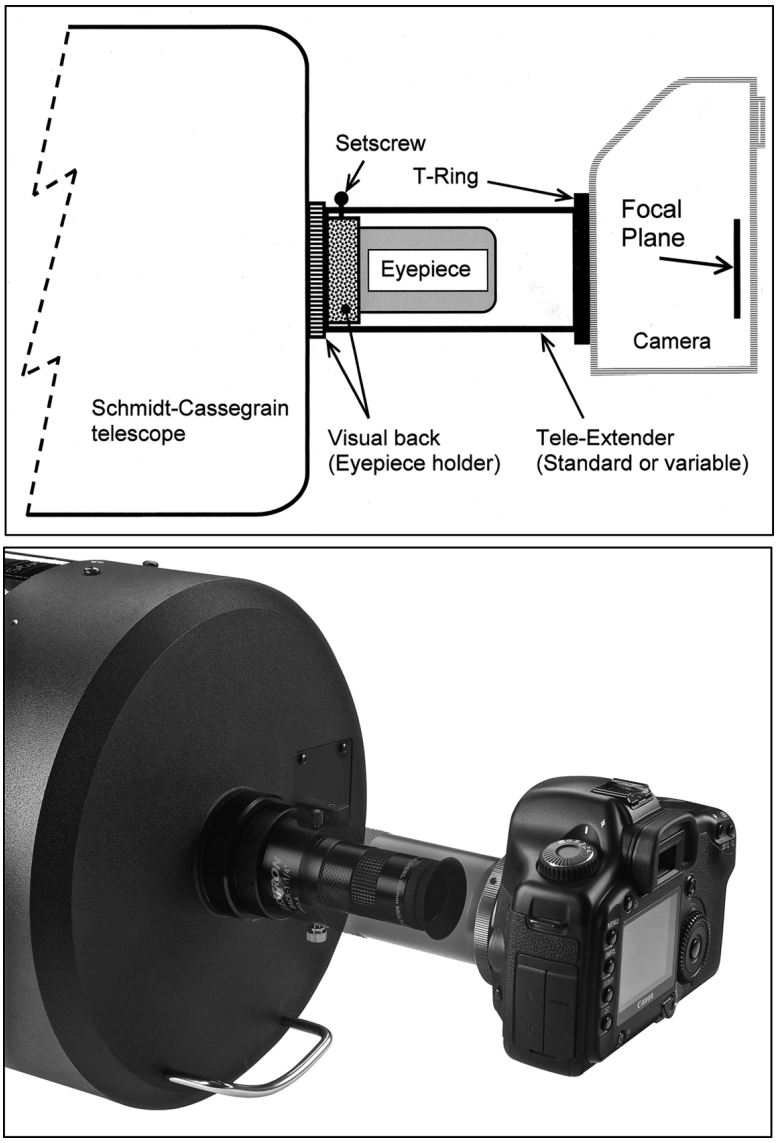

Figure 4-38. Eyepiece projection photography requires using an eyepiece projection adapter (projection tube), commonly called a tele-extender, which permits the telescope eyepiece to project an image directly onto the camera's image sensor. The tele-extender in the lower image, faded back to show the telescope eyepiece within it, is the Celestron® Deluxe Tele-Extender for Schmidt-Cassegrain telescopes. Do not confuse this type of tele-extender with the Canon and Nikon tele-converters (tele-extenders) because terminology is their only similarity. The Schmidt-Cassegrain telescope pictured here is the 2350mm f/10 Celestron C9.25″. Flat field eyepieces perform best for this application. Celestron and Meade Instruments Corporation both provide tele-extenders for eyepiece projection photography.

VIDEOGRAPHY: INTERMEDIATE-RANGE TO ULTRA-LONG-RANGE

Introduction

Photography is the recording of still images while videography is the recording of moving images.

Videography plays an important role in criminal investigations, intelligence collection, and special reconnaissance by military special operations forces. Although private investigators are not the target audience of this book, private investigation tradecraft has found its way into this book for a reason. The nature of many cases worked by private investigators requires recording moving video images, frequently from short- to intermediate-range and often on a spontaneous basis. The result is that many private investigators are very proficient surveillance videographers, especially when spontaneous recording is required. Private investigators are adept at recording moving video images when no time exists to mount a camcorder on a tripod or some other suitable support system.

Private investigators who are motivated, resourceful, dedicated to their profession, and who have the ability to think creatively have a great deal of tradecraft expertise to offer. The barriers and chasms separating government personnel from practitioners in the private sector need to dissipate. Barriers and chasms serve nobody and they impede progress. Detective Fredrickson, CPP, a 19-year veteran of the Phoenix, Arizona, Police Department, and President of Team Guardian, LLC, Investigation and Security Specialists, after watching a private investigation training video, reported the following observation.

> After watching the Surveillance CoPilot Tips training videos at the website of Investigative Training (www.investigativetraining.org), I feel compelled to mention that requirements sometimes differ for private investigators and law enforcement investigators. The nature of a case determines whether a video recording showing subject activity is necessary. In our case, doing surveillance as investigators assigned to the repeat offender program to apprehend repeat offenders during the commission of a crime, video is useful but not essential. After apprehending a subject during the commission of a crime, we appear in court and testify to what we observed. A video recording of the subject committing the crime is helpful but not essential. In contrast, the private investigator often must record the subject. For example, the private investigator doing surveillance on a subject to prove Workmans' Compensation fraud must record the subject engaged in activity that proves

> the claim is fraudulent. The investigator must provide the client with a video recording that shows the subject engaged in activity that the alleged injury would leave them unable to do. For example, if the subject claims a work related injury so severe they cannot bend or stoop the investigator must use a video camera to document them bending and stooping. The nature of many private investigation cases is such that private investigators must use a video camera to record subjects from very close distances and they have devised ingenious methods for accomplishing that. Criminal investigators need to be aware of the methods used by private investigators–they have much to contribute. (Detective Darin Fredrickson, personal communication, January 5, 2010)

Most consumer-grade camcorders, especially when used with a commercially available extender lens, are capable of the distances under which surveillance usually occurs in the urban environment. For example, the Canon VIXIA HV40 high-definition camcorder with the 1.7x tele-converter lens records subject identification (i.e., facial recognition) and legible vehicle number plates from 274 meters (300 yards).

In the semirural and rural environments, the observer-to-subject distances usually are great enough to require afocal coupling with a high-magnification telephoto lens or telescope. Afocal coupling involves filming through a telescope eyepiece on a telephoto camera lens or telescope.

This section addresses the use of off-the-shelf camcorders for intermediate-range videography and hybrid methods for long-range and ultra-long-range videography. The hybrid methods combine astrophotography and traditional terrestrial photography techniques as a means to use a camcorder with telephoto lenses made for digital single-lens reflex cameras and with Schmidt-Cassegrain telescopes. This section also addresses the use of digital single-lens reflex cameras featuring high-definition video capture.

A long-range and ultra-long-range videography capability by means of afocal coupling is necessary because observer to subject distances often exceed the capability of off-the-shelf camcorders, as stated. Unfortunately, the small size of camcorder image sensors imposes limitations (e.g., magnification sufficient to record essential detail can result in field-of-view being inadequate).

Using a digital single-lens reflex camera featuring high-definition video capture solves the magnification versus field-of-view problem, and the cameras perform well under low-light conditions (refer ahead to Figures 4-46 and 4-47). Unfortunately, at this time, DSLR camera video recording duration is limited, which requires that the surveillance specialist periodically stop and restart the camera. Canon explains that, "The EOS 5D Mark II will record movies up to 4GB per clip, which is approximately 12 minutes of movies at

Figure 4-39. Mounting a camcorder and digital single-lens reflex camera side-by-side so that they move as an integrated unit permits simultaneous recording of moving video images and high-resolution still images. Be creative—consider using a DSLR camera featuring high-definition video capture. Supporting the apparatus is the Majestic #1001 3/8″ Screw Mount Gearhead with 6″ x 7″ Camera Platform, this head featuring a load capacity of 15.88 kilograms (35 pounds). The mini-geared head supporting the camcorder permits precise alignment of the two camera systems. If frequent panning is necessary to follow a moving subject, use a heavy-duty fluid head in place of the geared head.

full HD resolution or approximately 24 minutes in standard definition. Video clips are recorded in .MOV format using an MPEG-4 movie compression . . .” (Canon U.S.A., Inc., 2010, n.p., *EOS 5D Mark II*).

When recording subject activity is necessary but recording exceptional detail is also required, two possibilities exist. First, two specialists work together as a team, one specialist using a camcorder and the other using a digital single-lens reflex (DSLR) camera. One specialist records moving video images while the other records detailed still images. Second, one specialist records both moving video images and high-definition still images using a camcorder and DSLR camera mounted parallel on one tripod, the camera/camcorder system moving as an integrated unit (see Figure 4-39). Mounting camera/camcorder systems side-by-side applies also to night vision photography (refer to Figure 5-13 in Chapter 5). This side-by-side method also permits using the camcorder to film a wide view of the scene and using the DSLR camera video mode to film a close-up view of the subject’s activities.

Full-frame DSLR cameras feature a large image sensor, 24 x 36 millimeters, and it is the large size of the sensor that permits using high-magnification lenses and still have adequate field-of-view. The same lens on a camcorder leaves one with limited field-of-view. For example, the 1/2.7-inch CMOS Sensor of the Canon VIXIA HV40 camcorder measures only 4.04 x 5.37 millimeters, the sensor featuring only about 1/40th the area of the 24 x 36 millimeter sensor of a full-frame DSLR camera. The Canon VIXIA HV40 camcorder featuring a 7.15x focal length conversion factor means that a given lens on the camcorder will feature less than one-seventh the field-of-view than the same lens on a full-frame DSLR camera. The small image sensor in camcorders is the primary reason that using a DSLR camera to record high-definition still images or moving video mages sometimes must occur simultaneously with the recording of moving video images using a camcorder.

Intermediate- and Moderate-Range Videography

Although prosumer and professional grade camcorders outperform consumer grade camcorders, the latter are small and affordable which makes them desirable for clandestine applications.

When comparing prosumer and professional-grade camcorders against consumer-grade camcorders, differences are apparent. Prosumer and professional-grade camcorders feature comparatively large image sensors, large lenses, and they permit a full range of manual control. Moreover, they feature three CCD or CMOS image sensors, which enhance image quality. For these reasons, prosumer and professional-grade camcorders outperform consumer-grade camcorders.

Consumer-grade camcorders feature small image sensors, short focal length lenses, and limited manual control options. On the plus side, however, small image sensors and short focal length lenses make miniaturization possible, which is essential for many clandestine applications.

Small physical size and automation makes consumer-grade camcorders useful for short- to moderate-range clandestine videography and they are useful for fast-moving situations. Nevertheless, the features that make miniaturization and low cost possible are the same features that render consumer-grade camcorders less efficient than prosumer and professional-grade camcorders, for some applications. In low-light situations, consumer-grade camcorders cannot perform as well as their larger counterparts and neither do

they perform as well when used with an image intensifier night vision device (NVD).[10]

Some prosumer- and professional-grade camcorders accept interchangeable lenses. Consumer-grade camcorders feature a permanently installed lens, some lenses featuring a fixed focal length and some featuring a zoom lens (i.e., variable focal length lens). Many consumer-grade camcorders accept an auxiliary tele-converter lens that increases the effective focal length of the lens. Common tele-converter magnification factors are 1.5x, 1.7x, or 2x depending on the camcorder make and model. When mounting a tele-converter lens in front of the permanently installed camcorder lens, one is doing afocal videography. Some afocal tele-converter lenses require an adapter ring while others do not. Auxiliary tele-converter lenses contain an erector lens to keep the image upright.

Physical surveillance in the urban environment typically features an observer-to-subject distance from 91.44–274 meters (100–300 yards). The surveillance specialist can use off-the-shelf consumer-grade camcorders for those distances. An auxiliary tele-converter lens makes moderately long-range videography possible (see Figure 4-40 and refer to Figure 2-34 in Chapter 2).

Ultra-Long-Range Videography

> Relative to afocal coupling, "The most important thing to remember is that it's not enough to make everything fit together mechanically; you must also consider the spacing between optical elements, and not all configurations work with all telescopes. . . . Unlike prime-focus photography, afocal coupling works with any telescope and almost any camera. The camera need not be an SLR, and the telescope need not have any more back focus than is needed for visual observing" (Covington, Michael, 2007, pp. 49, 75, *Digital SLR Astrophotography*).

During the following discussion of camcorder applications for ultra-long-range videography, realize as stated that Canon and Nikon offer full-frame and crop-sensor digital single-lens reflex (DSLR) cameras featuring high-definition video capture. The video capture mode of DSLR cameras offers attractive potentials for manual clandestine videography that conventional

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10. When photographing with an image intensifier night vision device (NVD), high ISO and a high level of NVD variable gain degrades image quality. The extent of image degradation depends on the level of ambient illumination and characteristics of the camera or camcorder. Lack of ISO control leaves consumer-grade camcorders less efficient than prosumer and professional-grade camcorders when used with an image intensifier night vision device. Even so, night vision videography using a consumer-grade camcorder works, although results often are disappointing.

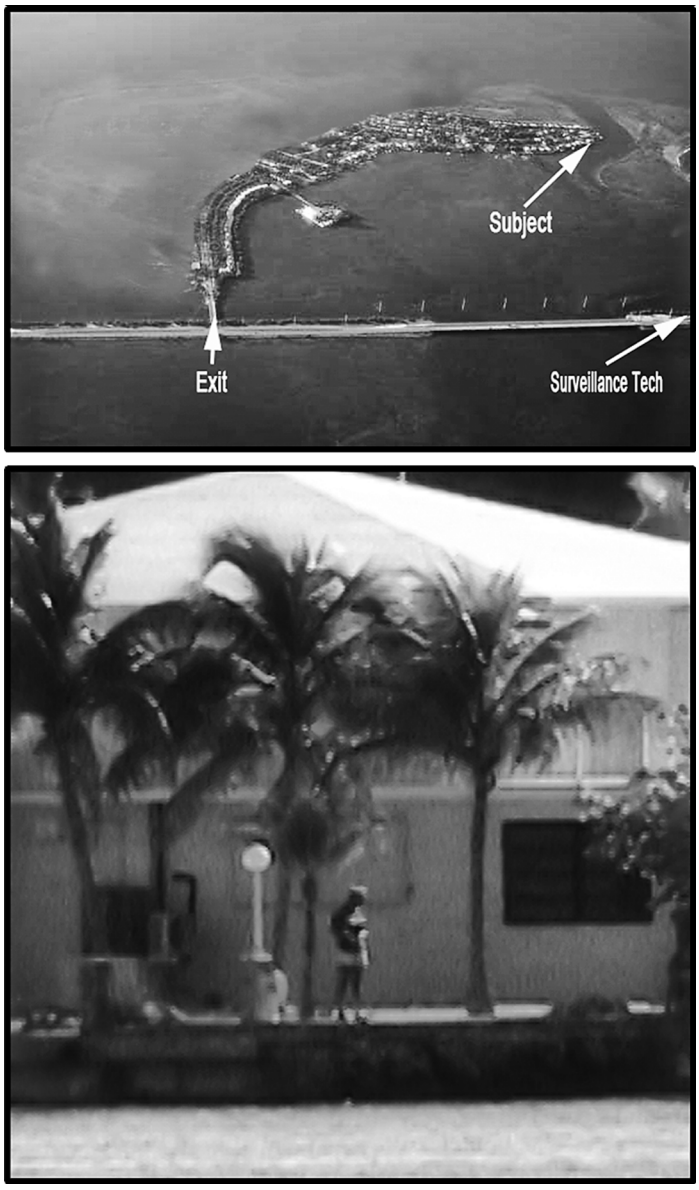

Figure 4-40. *Camera-to-subject distance:* 1.06 kilometers (0.66 mile). This distance is in the ultra-long-range category. This single frame extracted from moving video images shows that consumer grade camcorders with an auxiliary tele-converter lens are capable of impressive results from long distances. The surveillance specialist, a private investigator, recorded this subject using the Canon Elura 100 digital camcorder at full zoom with the 1.7x tele-converter lens. This camcorder features a 1/5″ CCD image sensor and a 3.0-60mm f/1.8-3.6 20x zoom lens. Maximum focal length with the 1.7x tele-converter lens attached is 102mm. Moving video images show subject activity and body language, and the surveillance specialist's testimony supports the video. Images courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

camcorders are poorly equipped to duplicate. Nevertheless, conventional camcorders for ultra-long-range clandestine videography remain useful.

Consumer-grade camcorders are small, lightweight, user friendly, and economical. Afocal coupling using a consumer grade camcorder with a moderately priced refractive or reflective telescope provides an ultra-long-range videography capability at low cost. In addition, consumer-, prosumer-, and professional-grade camcorders offer extended filming duration.

Finally, afocal coupling is necessary for long-range and ultra-long-range videography using a night vision device with one exception. The Electrophysics AstroScope™ Night Vision Module configured for use with Schmidt-Cassegrain telescopes and DSLR cameras provides the means to do direct coupling (prime focus) night-vision videography from extreme distances.

Relative to the high-definition video capture feature of the Canon EOS-1D Mark IV digital single-lens reflex camera, Canon reports that:

> The EOS-1D Mark IV captures video with all the benefits of shooting with an EOS digital SLR. . . . By shooting video with a large sensor camera, photographers as well as videographers can take advantage of the creative features native to SLR photography. Along with its manual controls, the EOS-1D Mark IV allows for full use of Canon EF lenses. . . . The resulting HD video is a standout in its stunning depth-of-field characteristics, remarkable capture capability under poor lighting conditions with its vast ISO range, and deep clean blacks with nearly undetectable noise. . . . Full manual exposure control is also available while shooting video when the camera is set to Manual mode. (Canon U.S.A., 2010, n.p., *Advanced Movie Recording for Myriad Applications*)

When using off-the-shelf photographic equipment, the surveillance specialist can record detail from greater distances using a digital single-lens reflex camera than when using a camcorder. John T. Nason (2004, May, n.p.) of the Federal Bureau of Investigation explains, "The overall picture quality of still photos generally proves superior to video, even when obtaining a freeze-frame. Additionally, telephoto lenses needed in surveillance photography are more readily available for still cameras." Recording useful moving video images from extreme distances using a camcorder requires hybrid methods, although the limitations imposed by the small size image sensor of camcorders persist.

Stated earlier, using afocal coupling for long-range and ultra-long-range clandestine videography is a hybrid method combining astrophotography and terrestrial photography techniques. Afocal coupling can greatly increase magnification and therefore increase camera-to-subject distance. This method often is necessary for rural operations because observer-to-subject dis-

tance usually is great, 0.40–1.61 kilometers (0.25–1 mile) or more. Nevertheless, the urban environment too can feature significant camera-to-subject distances.

Except when using a DSLR camera featuring high-definition video capture, ultra-long-range videography requires using a camcorder with a super telephoto camera lens, a refracting telescope, or a Schmidt-Cassegrain telescope by means of afocal coupling (see Figures 4-41 and 4-42). For this application of videography, the surveillance specialist can use a consumer-, prosumer-, or professional-grade camcorder. When selecting a camcorder for afocal videography, realize that larger image sensors provide a wider angle-of-view, which permits using greater magnification.

Important: When camera adapting a motorized telescope, place a small shot bag on top of the telescope to compensate for the weight of the camera; balance the telescope! When using the telescope with a camera adapted image intensifier night vision device, either a monocular or the AstroScope, weight and length increases so balancing the telescope becomes especially important. Proper balance prevents damaging the telescope drive mechanism consisting of servomotors and gears. When using a GPS-controlled telescope, experiment to become familiar with that feature before attaching a camera. If one activates the telescope with a camera attached and the telescope automatically begins looking for a specific overhead star to orient itself, it will rip the camera off the telescope; the camera will not clear the bottom of the double-tine fork mount. That will be a costly mishap–do not let it happen! Ensure that the telescope is in manual mode before attaching a camera or camera adapted night vision device.

The afocal configuration featured above provides useful options relative to effective focal length and f-ratio. Using different focal length eyepieces and varying the focal length of the camcorder zoom lens permits increasing and decreasing magnification and f-ratio. When magnification increases, f-ratio decreases. When magnification decreases, f-ratio increases.

The afocal configuration, illustrated above, with the camcorder zoom lens set at 10 millimeters and a 50-millimeter eyepiece on the telescope, would provide an effective focal length and f-ratio of 610mm f/2. A 610mm f/2 lens is remarkably fast! Increase the camcorder zoom lens to 30-millimeters and place a 25-millimeter eyepiece on the telescope and the effective focal length and f-ratio becomes 3658mm f/12. Consider the following summary.

- Magnification increases and f-ratio decreases when the focal length of the telescope eyepiece is shorter than the focal length of the camcorder lens.

Figure 4-41. This afocal videography configuration features the Canon VIXIA HV30 high-definition consumer-grade camcorder, Canon EF 600mm f/4L IS USM super telephoto lens with a 2x tele-converter, and a 14.5mm telescope eyepiece. With the camcorder's zoom lens set at 10mm, the effective focal length and f-ratio of this optical configuration is 828mm f/5.5. Applying the 7.15x focal length conversion factor for this camcorder reveals a 35mm equivalent focal length of 5,920 millimeters. *The 35mm equivalent focal length pertains to angle-of-view not magnification!* Use no more magnification than necessary to record essential detail because increasing magnification reduces field-of-view. This afocal configuration works with camcorders and still cameras with and without an image intensifier night vision device (refer to Figures 5-13, 5-36, 5-37, 5-38, and 5-43 in Chapter 5). Telescope eyepieces produce an inverted image. That is the reason for the author-invented inversion bracket that positions the camcorder in the upside-down position. The camcorder being upside-down during recording eliminates the need for post-videography editing to upright the images. The SNAP[11] supporting the telephoto lens and camcorder sports two Manfrotto Micrometric Positioning Sliding Plates (focusing rails) that permit fine adjustment of the camcorder left/right and closer/farther from the telescope eyepiece. The SNAP provides fine up/down adjustment of the camcorder. For best videography results, use the SNAP with a fluid head as shown.

11. SNAP is an acronym for "Siljander-Neipert Afocal Platform," an innovative apparatus system named after the inventors. The SNAP permits efficient afocal coupling using conventional telephoto lenses with digital still cameras and camcorders with and without a night vision device (NVD).

Figure 4-42. The author-invented inversion bracket permits positioning the camcorder upside-down for filming and rotating it to the upright left position for easy access to the camcorder controls and to provide clearance for changing telescope eyepieces. Positioning the camcorder upside-down eliminates the need to use image-processing software to upright inverted images; the telescope eyepiece provides an inverted image. The modified Celestron 93626 Universal Digital Camera Adapter and Manfrotto Micrometric Positioning Sliding Plate (focusing rail) properly aligns the camcorder (Canon VIXIA HV30) with the telescope eyepiece for afocal videography. The telescope supporting this apparatus is the 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). The robust author-invented eyepiece holder (visual back) supports the camera adapter thus eliminating the need for the eyepiece itself to support the weight of this apparatus and endure leverage-force. This afocal configuration as shown, using a 40-millimeter telescope eyepiece and the camcorder zoom lens set at 10 millimeters, provides an effective focal length and f-ratio of 762mm f/2.5. F/2.5 is very fast for a focal length of 762mm making this a good configuration for low-light videography. Application of the 7.15x focal length conversion factor for this camcorder reveals a 35mm equivalent focal length of 5,448 millimeters. *The 35mm equivalent focal length pertains to angle-of-view not magnification.* This afocal configuration works with camcorders and still cameras with and without an image intensifier night vision device.

- Magnification and f-ratio are unchanged when the focal length of the telescope eyepiece and camcorder lens are the same.
- Magnification decreases and f-ratio increases when the focal length of the telescope eyepiece is longer than the focal length of the camcorder lens.

Use afocal coupling to increase magnification only when camera-to-subject distance exceeds the magnification capability of the camcorder when used with a dedicated tele-converter (i.e., tele-converter made for the particular camcorder). Distances beyond 274 meters (300 yards) usually require using the camcorder with a telephoto DSLR camera lens or telescope by means of afocal coupling. That is, to record detail such as subject identification and legible vehicle number plates. Long-range and ultra-long-range night vision videography always requires afocal coupling. *The exception is when using a DSLR camera featuring video capture with the AstroScope Night Vision Module configured for use with Schmidt-Cassegrain telescopes.*

When doing afocal videography, experiment with the camcorder zoom lens and try various telescope eyepieces to determine what combination provides best results under various circumstances (see Figure 4-43 and refer ahead to Figure 4-45).

For afocal photography and afocal videography, short focal length eyepieces provide a greater degree of magnification than long focal length eyepieces do. Nevertheless, when doing afocal photography or videography using a telephoto lens and greater magnification is needed, place a tele-converter on the lens before resorting to a shorter focal length eyepiece. That method generally provides better image quality. For example, a DSLR camera with a 50-millimeter lens used in conjunction with a 15-millimeter eyepiece on the Canon or Nikon 600mm f/4 telephoto lens provides an optical system featuring an effective focal length of 1999.99 millimeters. By comparison, placing a 2x tele-converter and 30-millimeter eyepiece onto the same lens provides an optical system featuring an effective focal length of 1999.99 millimeters. Both methods provide the same effective focal length and therefore the same magnification, but the second method, using a tele-converter with a longer focal length eyepiece, generally provides better image quality. Both methods result in the same effective f-ratio of f/13.33. For best results, to the extent that circumstances permit, ensure that eyepiece and camera lens compatibility exists relative to the field-of-view of each. Experimenting with the equipment one will use is important because of the numerous variables involved. Find the combination of apparatus that works best.

For afocal videography and photography, no physical union exists between the camera lens and telescope eyepiece–they are close but not

Figure 4-43. *Camcorder-to-subject distance:* 265 meters (290 yards). Both images recorded using the Photo Mode (freeze-frame) of the Canon VIXIA HV30 high-definition consumer-grade camcorder. Method is afocal coupling using the Canon EF 300mm f/2.8L IS USM telephoto lens fitted with a 14.5mm telescope eyepiece. *Upper image:* Camcorder zoom lens set at the minimum focal length of 6.1mm. Effective focal length and f-ratio of the optical system is 126mm f/1.8, which is less than the Canon 300mm f/2.8 lens in use but greater than the maximum focal length of the built-in zoom lens of the camcorder. *Lower image:* Camcorder zoom lens set at 16 millimeters. Effective focal length and f-ratio of the optical system is 331mm f/3, which is slightly greater than the 300mm f/2.8 lens in use and considerably greater than the maximum focal length of the camcorder's built-in zoom lens even when used with a 1.7x tele-converter. *At full zoom with the 1.7x tele-converter lens, this camcorder features a maximum focal length and f-ratio of 103.7mm f/5.1.* Relative to the lower image, afocal coupling increased magnification 3.19 times and increased the f-ratio by 1 2/3 stops over the camcorder built-in lens. The optical system became more powerful and faster. The focal length conversion factor for this camcorder is 7.15x resulting in the upper image featuring a 35mm equivalent focal length of 901 millimeters and the lower image featuring a 35mm equivalent focal length of 2,360 millimeters. *The 35mm equivalent focal length pertains to angle-of-view not magnification!*

mechanically joined. That being the case, for afocal videography and photography, the surveillance specialist can use super telephoto camera lenses of any brand name irrespective of the brand of camera or camcorder in use.

Lack of a physical union between the camera lens and telescope eyepiece means that the surveillance specialist can obtain obsolete telephoto lenses for a reduced price and use them for afocal videography and photography. For example, when Canon replaced the FD camera mount with the EF camera mount, the used FD mount telephoto lenses sharply declined in value. If one intends to use a telephoto lens only for afocal applications, obsolete lenses are a bargain. For example, at the time of this writing, B & H Foto & Electronics Corporation, an online retailer, offered the following used telephoto lenses:

- Canon 400mm f/4.5 FD mount manual focus telephoto lens–$429 (USD)
- Sigma 135-400mm f/4.5-5.6 APO DG Aspherical Autofocus Lens for Pentax–$439 (USD)
- Olympus Zuiko 600mm f/6.5 manual focus lens for OM-Series cameras–$499 (USD)
- Sigma 120–400mm f/4.5-5.6 DG OS HSM APO Autofocus Lens for Sony Alpha & Minolta Maxxum–$670 (USD)
- Tamron Telephoto 300mm f/2.8 LD IF Adaptall Manual Focus Lens–$799 (USD)[12]

Refer back to Figure 4-41 and scrutinize the SNAP. Some of the afocal coupling methods discussed up to this point, and night-vision photography methods presented in the next chapter, require using the SNAP. The SNAP is versatile in that it accommodates almost any camera or camcorder with and without a night vision device. It also accepts almost any telephoto lens fitted with a telescope eyepiece. Nevertheless, the nature of the apparatus requires that the surveillance specialist have a high level of technical expertise. Field

12. It seems this 300mm f/2.8 Tamron lens would be a good choice to use with a consumer-grade camcorder via afocal coupling. Matching the focal length of the telescope eyepiece and camcorder zoom lens setting would result in this lens performing as a 300mm f/2.8 lens which would be good for long-range low-light videography. The 7.15x focal length conversion factor of, for example, the Canon VIXIA HV40 would result in an angle-of-view equivalent to 2145mm telephoto lens on a full-frame DSLR camera. Varying the focal length of the camcorder zoom lens would increase/decrease magnification and angle-of-view. Once determining what telescope eyepiece works best with this lens and the camcorder of choice, construct a camera/lens specific platform to make them an integrated unit for ease of use. The platform would be reminiscent of the SNAP, but it would be small, lightweight, and camcorder/lens/eyepiece specific. Everything would fit in place with no optical alignment and spacing adjustments being necessary or possible. It would be as compact and lightweight as the size of the lens and camcorder permit.

personnel lacking specialized expertise would benefit by a platform made to accommodate a specific camcorder, telephoto lens, and telescope eyepiece (see Footnote #12). In the field, they would simply assemble the various components with proper alignment and spacing being automatic.

For more information about coupling cameras to telescopes, see *Astrophotography for the Amateur* by Michael A. Covington and published by Cambridge University Press, 1999.

Low-Light Videography

Best image quality results when using a prosumer- or professional-grade camcorder for low-light videography. Consumer grade camcorders perform efficiently during daytime hours and they perform well at night when adequate artificial illumination exists (see Figures 4-44 and 4-45). In poor lighting, consumer-grade camcorders do not perform as well as prosumer- and professional-grade camcorders do and none of the camcorders perform as well as a DSLR camera featuring high-definition video capture (see Figures 4-46 and 4-47).

PRINTING SINGLE IMAGES FROM VIDEO IS SOMETIMES NECESSARY

The nature of many cases requires recording moving video images to document a subject's activities. An additional value of moving video images is, stated earlier, the documenting of body language. Body language is "The gestures, postures, and facial expressions by which a person manifests various physical, mental, or emotional states and communicates nonverbally with others" (Body language, *The American Heritage Dictionary of the English Language, Fourth Edition,* n.d.).

Frequently, printing selective still images from moving video images is necessary. When submitting a surveillance video to the recipient, a few selective still prints serve as a sampling of what the video contains. In his book *Thwarting Enemies at Home and Abroad: How to be a Counterintelligence Officer,* originally published in 1987 and reprinted in 2009 because of demand, William R. Johnson addresses this issue. Read the following excerpt from his book realizing that he wrote it during the days of motion picture film cameras. Nevertheless, what he says has meaning today–what has changed is how the surveillance specialist meets contemporary needs. The excerpt features historical interest and it illustrates that although photographic technology has advanced, needs and tradecraft methods remain largely unchanged.

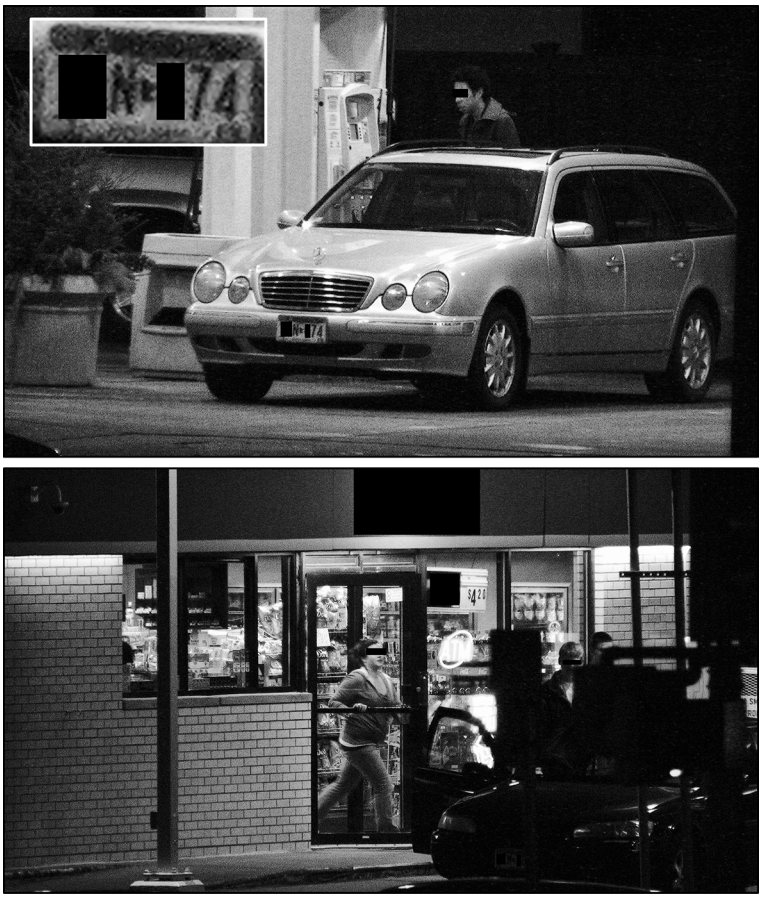

Figure 4-44. Nighttime single images recorded using the Photo Mode (freeze-frame) of the Canon VIXIA HV30 high-definition consumer-grade camcorder with the 1.7x tele-extender lens. *Camcorder-to-subject distance:* 117 meters (128 yards). Each subject is at the same gasoline service station market. With the 1.7x tele-converter lens, the effective focal length at full zoom is 103.7mm; the 35mm equivalent focal length relative to angle-of-view is 741mm. This is a common observer-to-subject distance in the urban environment. The upper image is cropped to show the detail the camcorder captures at that distance under that level of illumination; the vehicle number plate is legible.

> Photosurveillance frequently uses movie techniques. . . . When television cameras are used, projection is simpler, but making still prints requires special equipment. Still prints are essential and unavoidable. Suppose your problem is to identify your double agent's enemy handler. You have to be able to show him a selection of printed pictures ("mug book"), not hours of TV. (Johnson, 2009, p. 26)

Figure 4-45. Sunset camcorder image recorded using the Photo Mode (freeze-frame) of the Canon VIXIA HV30 high-definition consumer-grade camcorder. *Camera-to-subject distance:* 0.80 kilometer (0.50 mile). This is a greater than usual observer-to-subject distance for the urban environment. This image recorded at sunset with an effective focal length and f-ratio of 252mm f/1.8. This cropped single image illustrates that ultra-long-range videography is not only possible but that it is possible under marginal lighting conditions using a consumer-grade high-definition camcorder by means of afocal coupling. The surveillance specialist recorded this image two minutes after sunset; observe that the parking lot light is on. During sunset and sunrise, the outdoor illumination level is approximately 400 lux. On an average day, illumination ranges between 32,000 and 100,000 lux (Brillianz Ltd, 2006. n.p., *Innovation in the application of light*). Mounted on the author-invented user friendly SNAP (Siljander-Neipert Afocal Platform) was the camcorder and the Canon EF 600mm f/4L IS USM telephoto lens fitted with a 14.5mm telescope eyepiece (refer back to Figure 4-41 to view the apparatus). The camcorder zoom lens set at its shortest focal length of 6.1mm reduced image size but increased the effective f-ratio and thus improved low-light performance. Effective focal length and f-ratio (aperture) was 252mm f/1.8. Mathematical computations suggest 252mm f/1.68 but the camcorder lens's maximum aperture of f/1.8 prevails. Hence, the optical system was 252mm f/1.8. The camcorder 7.15x focal length conversion factor resulted in a 35mm equivalent focal length of 1,802mm relative to angle-of-view (*not relative to magnification*). Placing a tele-converter on the telephoto lens, or setting the camcorder zoom lens at a longer focal length, or both, would have increased magnification but diminished field-of-view and reduced the f-ratio thus decreasing low-light performance. For example, using the 600mm f/4 lens with a 2x tele-converter, 14.5mm telescope eyepiece, and setting the camcorder zoom lens at 20mm would provide an effective focal length and f-ratio of 1,655mm f/11. Unfortunately, the 7.15x focal length conversion factor of this camcorder would result in a 35mm equivalent focal length, relative to angle-of-view (not magnification), of 11,833mm, which could result in field-of-view being inadequate. Actual field-of-view would depend on camcorder-to-subject distance. For ultra-long-range videography, use a large image sensor camcorder to minimize the focal length conversion factor.

Figure 4-46. Subject photographed at night from a distance of 117 meters (128 yards) using the Canon EOS 5D Mark II digital single-lens reflex full-frame camera and Canon EF 100-400mm f/4.5-5.6L IS USM telephoto zoom lens at full zoom, 400mm. *ISO:* 25,600. *Aperture:* f/5.6. *Shutter speed:* 1/250 second. This is a common observer-to-subject distance in the urban environment. With the camera and lens tripod mounted and using the camera's mirror lock-up feature with a remote shutter release, the surveillance specialist recorded this nighttime image from inside a second level condominium. In the darkened room, the camera was located approximately 0.91 meter (3 feet) back from the partially open window.

Mr. Johnson stated that, "making still prints requires special equipment." Fortunately, today, digital imaging technology makes printing selective still prints from moving video images quick and easy.

LOW-LIGHT PHOTOGRAPHY: DSLR CAMERAS

Low-light clandestine photography is challenging. Darkness can render autofocus inoperative, the viewfinder image too dim for manual focusing, and even maximum ISO not being sufficient to provide a shutter speed fast enough to freeze the movement of human subjects.

Conventional Method

The most common way to achieve a suitably fast shutter speed under low-light conditions is to use a fast lens and high ISO. Generally, a shutter speed of 1/15th second will freeze movement of people and shutter speeds as slow as 1/6th of a second can produce a percentage of blur free images. In fact, as some of the next images verify, a shutter speed as slow as 1/2 second often permits recording usable images of people.

Figure 4-47. Examples of nighttime afocal DSLR camera photography and videography–117 meters (128 yards). The upper image is a single frame extracted from a video recorded using the high-definition video capture mode of the Canon EOS 5D Mark II digital single-lens reflex full-frame camera. Lower image recorded as a single frame still capture image. These comparative images illustrate why, when using a DSLR camera in high definition (HD) video mode, it is sometimes desirable for a second surveillance specialist to record single frame still capture images. One can shoot single frame images while recording video but that causes about a one-second interruption to video recording, which is unacceptable in some instances (refer back to footnote 8). *Afocal photography method:* 50mm f/1.4 lens on the camera. The surveillance specialist placed a 1.4x tele-converter and a 25mm telescope eyepiece on the Canon EF 300mm f/2.8L IS USM telephoto lens and then recorded single image still capture pictures and moving video images through the telescope eyepiece using the DSLR camera. That afocal optical configuration increased the effective focal length from 300mm to 840mm and reduced the effective f-ratio from f/2.8 to f/7.84. Still image recorded using ISO 3200, shutter speed 1/13 second. The tripod-mounted camera was inside a darkened second level condominium about 0.91 meters (3 feet) back from a partially open window.

Usually, people are not in constant motion–recording a blur-free image is possible when they pause briefly and when they are moving towards the camera. Photographing people using a slow shutter speed requires recording numerous sequential exposures to realize a percentage of blur-free images. When several subjects are present, only some individuals will be blur-free in each image.

Using the mirror lock-up or "electronic first shutter curtain" feature of a digital single-lens reflex (DSLR) camera prevents the action of the mirror causing vibrations. Photographers refer to the vibration causing action of the mirror as mirror slap. A remote release is necessary when using the mirror lock-up feature of a DSLR camera so that operating the camera without touching it is possible. Pressing the remote release button causes the mirror to assume the up position. Once the mirror is in the up position, wait a few seconds for vibrations to subside and then press the remote release button a second time to activate the shutter. Repeat that procedure to record sequential images.

The following illustrations and the accompanying captions provide insight into low-light clandestine photography, an application of photography fraught with variables (see Figures 4-48 to 4-55).

When darkness will render autofocus inoperative and make manual focusing impossible, prefocus the lens. During the daytime preliminary survey (reconnaissance), set the lens for manual focus, prefocus, and tape the focusing ring in place using gaffer tape. Gaffer tape tolerates temperature extremes and it leaves no sticky residue when removed. Alternatively, having determined camera-to-subject distance during the preliminary survey, focus on anything at that distance and tape the focusing ring in place so that the lens will be in focus once on site. Use as little focal length as the distance permits, doing that to maximize depth-of-field; increased depth-of-field better compensates for focusing discrepancies.

Circumstances do not always permit prefocusing the lens and that leaves the surveillance specialist making the best of a difficult situation. An aspect of the challenge is the low-light level requiring the use of maximum aperture, which reduces depth of field, which makes accurate focus more important. Unfortunately, achieving accurate focus under extreme low-light conditions often is difficult. Seize any opportunity to focus such as but not limited to the following.

- When a subject lights a cigarette, focus quickly on the light and the subject's face.
- When something shiny exists, such as light reflecting from vehicle chrome, focus on the reflection.

Figure 4-48. Nighttime image recorded from 59.44 meters (65 yards) with the camera handheld. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 200mm f/2L IS USM telephoto lens. *ISO:* 1600. *Aperture:* f/2. *Shutter speed:* 1/160 second. From inside a parked automobile the surveillance specialist recorded this nighttime photograph while handholding the camera. Easing the task of handholding the camera under this low-light condition was the optical image stabilizer providing up to four stops of stabilization correction. The upper image is a cropped portion of the lower uncropped image.

- When a subject opens a vehicle door, focus quickly on something illuminated by the vehicle interior courtesy light.
- In the event a vehicle arrives with the lights on, focus on one of the vehicle's lights. Alternatively, focus on something briefly illuminated by the headlights of the arriving vehicle.

Figure 4-49. This daytime aerial view shows the camera and subject locations relative to the previous illustration. The surveillance specialist was in the passenger seat of a parked automobile photographing across the front of the driver, photographing through the open driver side window.

Figure 4-50. Nighttime image recorded from 64 meters (70 yards). *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* Canon EF 200mm f/2.8L II USM telephoto lens. *ISO:* 1600. *Aperture:* f/2.8. *Shutter speed:* 1/60 second. Using the mirror lock-up feature and a remote shutter release, the surveillance specialist recorded this nighttime image from inside an automobile with the camera and lens on a vehicle window mount.

Figure 4-51. Nighttime image recorded from 117 meters (128 yards) using the Canon EOS 5D digital single-lens reflex full-frame camera and Canon EF 300mm f/2.8L IS USM telephoto lens with a 1.4x tele-converter. Effective focal length and f-ratio was 420mm f/4. *ISO:* 3200. *Shutter speed:* 1/60 second. With the camera and lens tripod mounted and using the camera's mirror lock-up feature with a remote shutter release, the surveillance specialist recorded this nighttime image from inside a second level condominium. In the darkened room, the camera was located approximately 0.91 meter (3 feet) back from the partially open window. Significantly, when photographing these subjects through the clean glass of the closed window, image quality was excellent. Visually detecting the surveillance specialist and camera from outside the building was impossible. *Note:* Compare the better quality of this image with the lower quality of the image in Figure 4-46. Image quality difference is primarily the result of differing ISO and to some extent differing maximum aperture (ISO 3200 versus 25,600 and f/4 versus f/5.6, a difference of 1 stop). Additional but lesser variables include the different DSLR cameras and lenses used (e.g., 300mm f/2.8 prime lens with a 1.4x tele-converter versus a 100-400 f/4.5-5.6 zoom lens).

Figure 4-52. Nighttime image recorded from 138 meters (151 yards). The upper image is a cropped portion of the lower image. With the camera and lens tripod mounted and using the camera's mirror lock-up feature with a remote shutter release, the surveillance specialist recorded this image from the fifth floor of a hotel. The camera was located approximately 0.91 meter (3 feet) back from the window, which no longer contained glass; the observer dismantled the window to remove the glass. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 300mm f/2.8L IS USM telephoto lens. *ISO:* 3200. *Shutter speed:* 1/40 second. *Aperture:* f/2.8.

- When the headlights of an unrelated vehicle briefly illuminate the subject, quickly focus.
- Focus on an unrelated object that is about the same distance from the camera.

Underexposure as a Low-Light Photography Technique

Sometimes, the level of nighttime illumination is so low that a shutter speed sufficient to freeze movement of human subjects is not attainable even at

Figure 4-53. Nighttime ultra-long-range photograph. *Camera-to-subject distance:* 1.21 kilometers (0.75 mile). *Camera elevation:* 32.61 meters (107 feet) above the ground; 11th floor of a high-rise building. The subjects are on the 9th and 10th floors of a high-rise building. The original high-definition image provides resolution sufficient to discern the type of beverage the can in the upper window contains, the white square identifying the beverage can. Ultra-long-range nighttime photography using a Schmidt-Cassegrain telescope (SCT) usually demands using the direct coupling (prime focus) method. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* 3048mm f/10 Meade 12″ LX90GPS Schmidt-Cassegrain telescope (SCT) providing 61x magnification. *ISO:* 1600. *Shutter speed:* 1/2 second. Thermal activity was minimal because of camera and subject elevation. *Method:* Direct coupling (prime focus) photography using the mirror lockup feature and a remote shutter release. *Know the law—know when a photographic penetration into a habitation is legal without the occupant's permission or without a warrant issued by a court of competent jurisdiction. Refer to Chapter 9, subheading Manual Clandestine Photography and the Law.*

maximum ISO. When that occurs, increase shutter speed to the minimum necessary to freeze subject movement and shoot to RAW. Later use a graphic editing program featuring an appropriate RAW processor to bring back the detail in the underexposed image.

Proper exposure at low ISO produces the best quality images. Unfortunately, low-light conditions usually require the surveillance specialist to increase ISO to achieve a suitably fast shutter speed, especially when photographing moving human subjects. In some instances, however, illumination is so low that maximum ISO fails to provide a suitably fast shutter speed. When

Figure 4-54. The surveillance specialist recorded this image using a tripod mounted Canon EOS 5D digital single-lens reflex full-frame camera and Canon EF 200mm f/2.8L II USM telephoto lens. *ISO:* 3200. *Aperture:* f/2.8. *Shutter speed:* 1/2 second. Darkness rendered auto-focus inoperative and the viewfinder image was too dim for manual focusing. During a brief opening of the vehicle door, the interior light of the vehicle permitted focusing. The two individuals are standing by an Aero Commander aircraft. People do not move continuously but alternate between moving and pausing. For that reason, when using a slow shutter speed, record numerous sequential images to record a percentage of blur-free images.

that occurs the surveillance specialist increases shutter speed to a usable level even though under exposure results. During postphotography editing, use a graphic editing program featuring an appropriate RAW processor to bring back the detail in the underexposed image. Shoot to RAW not JPEG when under exposing to achieve a suitably fast shutter speed, this critical point discussed and illustrated under the next subheading, *"JPEG versus RAW."*

Figure 4-55. Starlight image. The surveillance specialist recorded this nighttime image with the only illumination being starlight, starlight on a moonless night featuring approximately 0.001 lux. The number plate is not legible. Exposure time was 1.6 seconds, which is suitable only for stationary subjects. Human subjects usually do not remain motionless for an extended period, although exceptions exist. Subjects engaged in physical activity under lighting conditions such as this are difficult if not impossible to photograph. Conversely, two people standing idle while engaged in verbal conversation are largely motionless and photographing them is possible. When photographing human subjects using a slow shutter speed, it is important to record numerous sequential images in an effort to record a few usable blur-free images. Subject activity determines the percentage of usable images one will record. Sometimes, a suitable alternative to using maximum ISO and an insufferably slow shutter speed is to increase shutter speed to the slowest usable level even though serious underexposure will result and shoot to RAW. Use a graphic editing program featuring an appropriate RAW processor to bring back the detail in the underexposed image. Under exposing as a method to achieve suitably fast shutter speeds is the topic of the next subheading. *Method:* Tripod mounted camera, mirror lock-up, remote shutter release. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 100mm f/2 USM telephoto lens. *ISO:* 3200. *Aperture:* f/2. *Shutter speed:* 1.6 seconds.

Digital single-lens reflex (DSLR) cameras are becoming increasingly tolerant of underexposure. For example, the Canon EOS 5D digital single-lens reflex (DSLR) camera permits the surveillance specialist to underexpose by approximately 6.5 stops and record subject identification (i.e., facial recognition) and legible vehicle number plates. A greater degree of underexposure results in loss of subject identification although at nine stops underexposure, a weak but legible vehicle number plate is salvageable. Under extreme low-light conditions, underexposing to capture detail such as subject identifica-

tion and legible vehicle number plates works only when recording single (still) images. It does not apply when recording moving video images.

The dynamic range of modern DSLR cameras is significant and that permits underexposure. The extent to which one can under expose and record essential detail varies by camera make and model and it varies by level of ISO. Some ISO settings permit a greater degree of underexposure than other ISO settings do. With the Canon EOS 5D DSLR camera, ISO 400 appears to be the so-called "ISO sweet-spot" for underexposure

When underexposing to achieve a suitably fast shutter speed, underexpose only to the extent necessary. This is important because although modern DSLR cameras tolerate considerable under exposure, image quality progressively deteriorates as the extent of underexposure increases. Moreover, dynamic range decreases as ISO increases. The level of ambient illumination, the speed of the lens, the dynamic range of the camera, and the nature of the subject matter determines the extent to which underexposure is possible. Nevertheless, extreme underexposure is possible and sometimes that is the only way to record essential detail (see Figures 4-56 to 4-58).

The extent that increasing ISO and under exposing affects image quality varies by DSLR camera make and model, as stated. For that reason, record a series of test exposures with each DSLR camera model one uses and compare results. In the future, when extreme underexposure is necessary, use the camera that performs best for that application. Knowing the extent to which underexposure is possible with each DSLR camera one uses prevents using this method with a less suitable camera. Knowing that underexposure is possible prevents aborting a mission based on the incorrect belief that inadequate illumination exists for photography.

Knowing the extent to which underexposure is possible also prevents transitioning to use of an image intensifier night vision device for photography when so doing is unnecessary. Additionally, the ability to significantly underexpose enables one to close the time window in the morning and evening when it generally is too dark for available light photography but too light for night vision photography. Regarding this issue, FLIR Systems, Inc. reports that, "NVG [Night Vision Goggles] and other lowlight cameras are not very useful during twilight hours, when there is too much light for them to work effectively, but not enough light for you to see with the naked eye" (FLIR Systems, Inc., 2009, n.p., *What's The Difference Between Thermal Imaging and Night Vision?*). This situation applies to photography.

Historically, there was a time in the morning and evening when it was too dark for conventional photography and too light for night vision photography, as stated. Today, in the evening, as illumination progressively diminishes, the specialist increases ISO and, at some point, begins underex-

Figure 4-56. Nighttime image properly exposed. *Shutter speed:* 1/2 second. *Illumination:* One nearby streetlight. The upper left image is what appeared on the LCD monitor at the time the surveillance specialist recorded this image. The upper right image is the number plate cropped; compare this number plate with the cropped number plate in the next two illustrations. *Method:* Camera and lens tripod mounted, mirror lock-up mode used with a remote shutter release. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 100mm f/2 USM telephoto lens. *ISO:* 400. *Aperture:* f/2. *Atmosphere:* Good. When using a shutter speed this slow, record numerous sequential images to obtain a percentage of blur-free images.

posing to maintain a suitably fast shutter speed. He or she does that until it is too dark to use that method, or until it is dark enough to photograph with an image intensifier night vision device using a neutral density filter to reduce the amount of light reaching the faceplate of the NVD intensifier tube. Using neutral density filters with the NVD optical system permits transitioning to NVD photography under a higher level of illumination than otherwise is possible. That minimizes the extent that underexposure is necessary before transitioning to NVD photography. Refer ahead to Figures 4-63 and 4-64 to scrutinize the quality difference between high ISO nighttime available light images and low ISO image intensifier night vision images.

Figure 4-57. Nighttime image underexposed by 5.5 stops, shot to RAW. *Shutter speed:* 1/100 second. Underexposing by 5.5 stops increased shutter speed from 1/2 second to 1/100 second. *Illumination:* One nearby streetlight. The upper left image is what appeared on the LCD monitor at the time the surveillance specialist recorded this image. The upper right image is the number plate cropped. *Method:* Camera and lens tripod mounted, mirror lock-up mode used with a remote shutter release, deliberately underexposed to achieve a suitably fast shutter speed. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 100mm f/2 USM telephoto lens. *ISO:* 400. *Aperture:* f/2. *Atmosphere:* Good. In this and the previous illustration, the camera and subject locations are identical.

In some instances, the surveillance specialist alternates between recording low ISO high-resolution properly exposed time exposures and elevated ISO underexposed fast shutter speed images. Example: During the hours of darkness, multiple people arrive at the subject location at different times in different vehicles. As each vehicle arrives and during periods of outdoor human activity, the specialist uses elevated ISO and, if necessary, underexposes to achieve a shutter speed sufficient to freeze subject movement. Should the subjects go indoors and thus be out of view, the specialist switch-

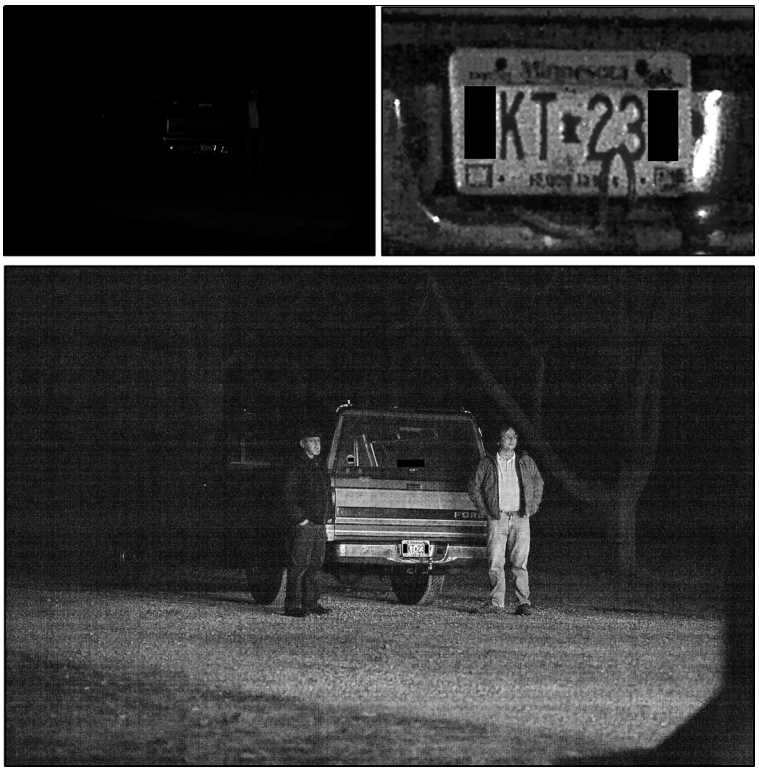

Figure 4-58. Nighttime image underexposed by 6.5 stops, shot to RAW. The upper left image is what appeared on the LCD monitor at the time the surveillance specialist recorded this image. The upper right image is the number plate cropped. The authors have recorded legible vehicle number plates when under exposing by as much as nine stops, but subject identification (i.e., facial recognition) was not salvageable. Comparison of this image with that in the previous illustration shows that while considerable underexposure is possible when shooting to RAW, there is a point beyond which image quality diminishes rapidly. There is only one stop difference between this and the previous illustration. This location is different from the previous two illustrations and the level of illumination is lower, both being variables. *Method:* Camera and lens tripod mounted, mirror lock-up mode used with a remote shutter release, deliberately underexposed to achieve a suitably fast shutter speed. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 100mm f/2 USM telephoto lens. *ISO:* 400. *Aperture:* f/2. *Shutter speed:* 1/25 second. *Atmosphere:* Good.

es to low ISO and records properly exposed high-resolution time exposures of the vehicles so that the images reveal detail such as legible vehicle number plates. Having done that, the specialist reverts to the previous high ISO underexposure settings to freeze subject movement as people emerge from the building.

Deliberately underexposing several stops is something most photographers would consider to be in violation of the rules of photography and in most cases where cosmetic appeal of the final image is the goal, they would be right. Nevertheless, the clandestine photographer is concerned about recording essential information and not concerned about any rules of photography he or she may violate in the process.

During night vision photography using an image intensifier night vision device, never underexpose to achieve a faster shutter speed. Underexposure during night vision photography rapidly degrades image quality.

JPEG versus RAW

> Shoot to RAW not JPEG when underexposing to achieve a suitably fast shutter speed, this point being critically important!

Previous discussion addressed the fact that nighttime illumination is sometimes so low that maximum ISO cannot provide a shutter speed fast enough to freeze subject movement. In such instances, the surveillance specialist uses a suitably fast shutter speed anyway knowing that under exposure will result. Later, using a graphics-editing program featuring an appropriate RAW processor, the specialist salvages the images. The specialist uses the graphics-editing program to compensate for the underexposure.

Discussion emphasized shooting to RAW, not JPEG, when under exposing. When shooting to JPEG, the camera discards much of the information at the time of photographing. No loss of information occurs when shooting to RAW, which leaves the specialist with all information. Having all information with which to work during digital postprocessing makes a significant difference in the quality of the resultant image (see Figure 4-59).

BACKLIGHTING: PROBLEMS AND SOLUTIONS

> Lighting is the most important technical aspect of any photograph. Cameras, lenses, and everything else are completely irrelevant unless you have good enough light to make a good photo. (Rockwell, 2009, n.p.)

Frequently, circumstances result in the surveillance specialist photographing a subject illuminated predominantly from behind. That occurs during the day and at night. Sometimes, during the day, the sun is behind the subject. At night, moonlight or artificial illumination is sometimes behind the subject with little or no frontal lighting.

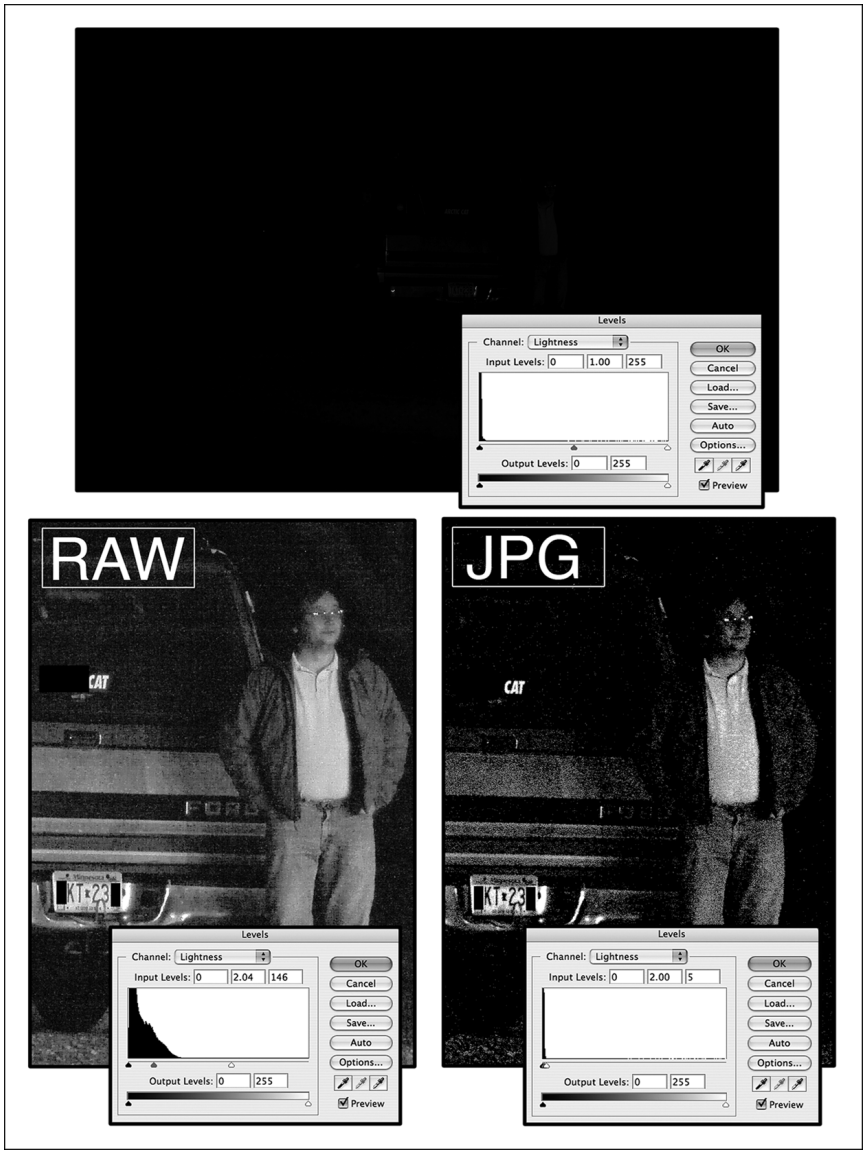

Figure 4-59. Before recording this image, underexposed by 6.5 stops, the surveillance specialist set the camera to shoot to both RAW and JPEG. The upper image shows what appeared on the camera LCD monitor at the time of photographing, no salvageable image being apparent. Using a graphics-editing program the specialist salvaged both the RAW and JPEG images, but the RAW image is superior. Pay particular attention to the amount of detail in the histogram of the image processed from the RAW capture vs. the JPG. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 100mm f/2 USM medium telephoto lens (Canon categorizes their telephoto lenses as Medium Telephoto, Telephoto, and Super Telephoto.). *ISO:* 400. *Aperture:* f/2. *Shutter speed:* 1/25 second.

At night, if the level of frontal illumination is greater than illumination originating behind the subject, correctly exposing the subject is not a challenge. Conversely, when backlighting is stronger than frontal lighting, or when no frontal lighting exists, properly exposing the subject is more challenging. A similar situation occurs when snow covers the ground–the camera's internal light meter reads the snow rather than the subject.

In the circumstances described, the camera's internal light meter responds to the dominant illumination sources and provides an exposure reading that leaves the subject underexposed. The subject is a silhouette against a bright background. When photographing backlit subjects, control exposure manually and bracket exposures. Properly exposing a backlit subject requires overexposure of the bright background (see Figures 4-60 and 4-61 and refer to Figures 2-31 and 2-32 in Chapter 2). Those without experience photographing people in backlit situations should enlist the aid of a friend or colleague and experiment by photographing them under a variety of backlighting situations.

THE DECISIVE MOMENT

> Jean François Paul de Gondi, Gardinal de Retz (1613–1679) expressed it well when he said, "There is nothing in this world that does not have its decisive moment." (Gecker, J., 2004, August 4, n.p.)

> Henri Cartier-Bresson (1908–2004), French photojournalist, wrote in his book *The Decisive Moment,* "Above all, I craved to seize the whole essence, in the confines of one single photograph, of some situation that was in the process of unrolling itself before my eyes." (BrainyMedia.com, 2010, n.p., *Henri Cartier-Bresson*)

Like the legendary French photographer Henri Cartier-Bresson, the surveillance specialist endeavors to photographically document the so-called decisive moment. The decisive moment is the point in time that events converge and tell the story. Regarding Cartier-Bresson's concept of the decisive moment, journalist Jocelyn Gecker (2004, August 4, n.p.) explained that, "His concept of photography centered on what he described as 'the decisive moment'–the moment evoking the ultimate significance of a given situation as all the external elements fall perfectly into place."

Technically perfect photographic images are of no value if they fail to contain useful information. Still pictures and moving video images have value only when they provide information pertinent to the mission. Photograph subjects while they commit a crime and images of value result.

Figure 4-60. Although some illumination falls onto this subject from the front, this is an extreme backlighting situation by virtue of the intensity of the security lights behind the subject. *Upper image:* Overview recorded using a 50mm f/1.4 lens. *Lower image:* Telephoto view using the Canon EOS 5D digital single-lens reflex full-frame camera and Canon EF 200mm f/2.8L II USM telephoto lens.

Photograph subjects before or after the commission of a crime and information of value is lacking relative to the commission of the crime. Photographic images of a drug buy, for example, must identify the actors and show the exchange of drugs and money; the transaction often occurs quickly. The exchange of drugs and money is the decisive moment–timing is critical. Photographs that show the subject approaching and later walking away from a parked vehicle provide no value in the absence of at least one image showing a transaction occurring between the subject and the vehicle occupant, the transfer of drugs and money.

Figure 4-61. This is a cropped portion of the lower image in the preceding illustration. In spite of severe backlighting, image detail is good.

Some subject matter is static (i.e., stationary). When photographing stationary subject matter, it usually matters little exactly when the surveillance specialist records the image. Photographing stationary subjects generally is not a time sensitive issue because there is no decisive moment. For example, relative to photographically documenting the number plate of a parked vehicle, it matters not whether the specialist records the photograph at the moment or two minutes later. This often is not true when photographing human subjects.

When photographing people, the surveillance specialist endeavors to document such things as the subject's face, clothing, items the subject is carrying or using, behavior and interaction with other people. Some factors such as clothing and facial features contain no specific decisive moment. Let the subject begin forcing entry into a building for the purpose of burglary and a decisive moment exists. A decisive moment may be as brief as one person handing something to another person during a drug buy or during an innocent-looking "brush" encounter while passing each other in a public location. Alternatively, an event can consist of a series of sporadic decisive moments.

Two photography teams are sometimes necessary, one team to record subject activity using a camcorder and a second team to record high-defini-

tion still images. Still images contain finer detail than video images do. In some instances, one surveillance specialist can operate a camcorder and digital single-lens reflex camera mounted side-by-side as an integrated unit (refer back to Figure 4-39 and refer to Figure 5-13 in Chapter 5 and Figure 6-35 in Chapter 6). Two or more photography teams may be required to record subject activity from multiple vantage points, but even then, each surveillance specialist can sometimes operate a side-by-side mounted camera and camcorder.

ACHIEVING MAXIMUM IMAGE QUALITY

> Regarding intelligence photography, "Elastic requirements for useful photos, but stringent specifications for the best." (Bofrone, 1993, September 22, n.p.)

Introduction

The surveillance specialist sometimes engages in photography under field conditions so unfavorable that photographers in other genres would hesitate to attempt it. Manual clandestine photography is one of the most challenging applications of photography there is for several reasons. The specialist must record photographic images from long distances under adverse lighting and weather conditions, traverse and occupy inhospitable terrain, and often work in a hostile and active countersurveillance environment. Moreover, working in secrecy is essential; the subject and other people must be unaware that photography is occurring.

In spite of the challenges requiring management, the surveillance specialist must record useful photographic images. Among the things that the specialist does to record quality photographic images, preventing vibration of the camera and lens during photographing is paramount. The greater the magnification of the optical system, the more vibrations become an issue that require management. Keep in mind that surveillance specialists sometime use an effective focal length exceeding 5,000 millimeters with 3000+ millimeters being very common. Fortunately, the specialist can do a number of things to eliminate or at least minimize vibration of the optical system while photographing (see Figure 4-62).

German equatorial mounts made to support telescopes for astronomical viewing and astrophotography point the lens upward only. Hence, an accessory wedge to reposition the telescope is necessary for terrestrial photography. For terrestrial photography, altazimuth (altitude-azimuth) mounts and fork mounts are more practical than German equatorial mounts (refer back

Figure 4-62. The surveillance specialist using this 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) for prime focus (direct coupling) photography has implemented a number of measures to minimize image-degrading vibrations. The two shot bags, one on the lens and one hanging from the tripod, dampen vibrations and leave the apparatus less susceptible to wind induced movement. The vibration isolation/suppression pads under the tripod feet reduce the time that the tripod and scope resonates with vibration by nearly 100 percent and they decrease the amplitude of the vibrations. Vibration isolation pads are applicable when the tripod is on grass, dirt, concrete, asphalt, and wood surfaces. The Bogen-Manfrotto 359 Long Lens Support between the camera and tripod leg provides added support to minimize vibration of the camera and telescope assembly. The remote release hanging from the camera enables the surveillance specialist to operate the camera without touching it. The author-invented triangular shaped wedge between the German equatorial mount and telescope permits using the apparatus for terrestrial photography. During daylight hours, a focusing cloth draped over the camera and surveillance specialist's head makes critical focusing easier. This telescope weighs 9.07 kilograms (20 pounds) exclusive of the equatorial mount and tripod assembly. Stability of the optical system is critical–the horizontal angle-of-view of the direct coupling (prime focus) camera and lens assembly shown here is less than one degree, specifically 0° 53′.

to Figure 4-19). Using the tripod as illustrated above with the German equatorial mount requires precise initial positioning of the telescope relative to the subject so that framing adjustment requires limited horizontal panning of the telescope. With the telescope supported by the wedge, horizontal panning causes the telescope to tip downward. *Note:* After recording the image for the previous illustration (Figure 4-62), the authors took the German equatorial mount into their machine shop and modified it so that it works for terrestrial photography without the wedge (refer to Figure 3-14 in Chapter 3).

Achieving maximum image quality when using a camera or camcorder is the ambition of every surveillance specialist and several things contribute to high quality images, several already discussed and illustrated. The following list identifies practical things that contribute to the recording of quality photographic images, many of the points requiring little or no elaboration.

- *Shoot to RAW when using a DSLR camera.* Shoot to RAW to avoid losing information. When working RAW images using a graphics-editing program the surveillance specialist has all the information with which to work. When shooting JPEG images, the camera discards much of the information at the time of photographing. Discarded information is forever lost (refer back to Figure 4-59).
- *Underexpose at night when necessary to achieve a suitably fast shutter speed.* Many modern digital single-lens reflex cameras tolerate considerable under exposure (refer back to Figures 4-56 to 4-58). Always shoot to RAW when under exposing!
- *The digital darkroom.* To maximize the quality of each image, be proficient with an appropriate graphics-editing program. Imaging software is the so-called digital darkroom. Imaging software works best with images in RAW format, especially when working marginal-quality images recorded under adverse lighting conditions. Never work/modify images intended to serve as evidence in a court of law. Rather, edit a copy of the original image. *Never edit the original image!*
- *Quality lens (good glass).* Use high quality telephoto lenses and telescopes because they produce better image quality than low cost products do.
- *Proper collimation.* When using a Schmidt-Cassegrain telescope (SCT), ensure proper collimation to maximize image quality.
- *Thermal equilibrium.* Set up early enough to provide the telephoto lens or telescope time to achieve thermal equilibrium. That is, provide time for the temperature of the optical elements (e.g., lenses and mirrors) within the lens system to equalize, and provide time for the optical system as a whole to equalize with the ambient temperature. The length

of the tube containing optical elements changes as temperature changes and that causes a shift in focus. Thermal equilibrium is important with all high-magnification lenses, but it is especially important when using a Schmidt-Cassegrain telescope (SCT). Unfortunately, when photographing from an outdoor vantage point while ambient temperature is rapidly increasing or decreasing, thermal equilibrium of the optical system cannot occur.

- *Quality camera.* Use a quality prosumer- or professional-grade camera. A prosumer is an amateur whose knowledge and sophisticated needs require equipment with professional features. Prosumer-grade cameras are adequate for most professional applications whereas consumer grade cameras are inadequate for many but not all professional applications. Surveillance specialists do a lot of quality videography using high-definition consumer-grade camcorders.
- *Camera and lens support.* Vibration of the camera and lens assembly creates unclear images if the shutter speed is not fast enough to compensate for the vibrations. The greater the magnification the more vibrations become amplified. Use a quality heavy-duty tripod, the Bogen-Manfrotto 359 Long Lens Camera Support, and place a shot bag on the lens and suspend another from the tripod to minimize vibrations (refer back to Figure 4-62). When necessary, use two tripods. One tripod supports the telephoto lens or telescope in the usual manner and the second tripod supports the camera or front of the lens (refer back to Figure 4-27).
- *Fast shutter speed.* Use as fast a shutter speed as conditions permit. A fast shutter speed "freezes" movement of the subject and it compensates for vibrations of the camera and lens assembly. Use maximum lens aperture and high ISO when necessary to achieve a suitably fast shutter speed. If necessary, underexpose to achieve a suitably fast shutter speed and compensate for underexposure during postphotography editing using a graphics-editing program. When underexposing, shoot to RAW. When using an image intensifier night vision device (NVD) for photography, never underexpose. Similarly, increase ISO and the level of NVD manual variable gain only as much as necessary. Night vision devices are intolerant of underexposure and increasing ISO and manual variable gain tends to degrade image quality. Increasing NVD manual variable gain degrades image quality quicker than increasing ISO does, so find a compromise between the two.
- *When using a DSLR camera and circumstances permit, minimize mirror action vibrations by avoiding certain shutter speeds.* Photographer Bob Atkins (2010, October 16, n.p.) addresses this issue in one of his online

tutorials. He explains that, "The loss of image sharpness is worst at intermediate shutter speeds. . . . At very fast speeds the shutter is only open for a small part of a vibrational cycle, while at long shutter speeds the vibrations can die out, so only a small part of the total exposure is taken while the camera is shaking. . . . In general, for lenses of 300mm and over . . . users should try to avoid using shutter speeds between 1/30 and 1/4 second for optimal sharpness." This does not apply when using the DSLR camera mirror lock-up or "electronic first shutter curtain" feature.

- *Vibration isolation pads.* Place vibration isolation pads under the tripod feet (refer back to Figure 4-62).
- *Low ISO.* Low ISO provides better image resolution than high ISO does. Unfortunately, circumstances do not always permit using low ISO.
- *Record numerous sequential images.* During extreme-distance low-light high-magnification photography, and during night vision photography, shutter speed is sometimes insufferably slow. When shutter speed is slow, record numerous sequential images knowing that many will be unacceptable because of apparatus vibration and subject movement but some images will be usable. During extreme distance photography, the fluid nature of the atmosphere also requires recording numerous sequential images, this issue previously discussed.
- *Mirror lock-up.* When using a DSLR camera with a high-magnification lens or telescope, use the mirror lock-up feature to prevent the action of the mirror causing image-degrading vibrations. When using the mirror lock-up feature, also use a remote shutter release.
- *Electronic first shutter curtain.* Use the "electronic first shutter curtain" feature of a digital single-lens reflex (DSLR) camera, discussed shortly under the subheading *Electronic First Shutter Curtain.*
- *Remote shutter release.* A remote shutter release enables the surveillance specialist to operate the camera without touching it. Touching the camera always causes unwanted movement of the apparatus.
- *Focus manually.* Many lenses feature automatic focus (auto-focus) which is useful in many instances. To achieve "perfect" focus of the subject or some object within the scene, surveillance specialists often focus manually.
- *Properly expose the images when circumstances permit.* Proper exposure is important; overexposure and underexposure degrades image quality. ISO ratings of cameras are rarely exacting. Usually the sensitivity of a camera's CCD or CMOS is slightly less than the ISO rating states. Therefore, to ensure the most accurate exposure possible, use an

external light meter to test the accuracy of the camera's internal light meter and then manually adjust exposure to compensate, or adjust the light meter accordingly. Alternatively, set the camera to bracket exposures. When photographing with an image intensifier night vision device (NVD), the internal light meter of DSLR cameras tends to be inaccurate. For example, when the internal light meter of the Canon EOS 5D digital single-lens reflex camera indicates proper exposure, underexposure by approximately one stop occurs. Exposure compensation is necessary. *The light meter of a DSLR camera anticipates a white light image, not a green monochromatic NVD image.*

- *Bracket exposures.* When bracketing exposures, the surveillance specialist records an image at what appears to be the correct exposure and then records two additional images, one over and one under the exposure of the first. Most if not all DSLR cameras feature Auto Exposure Bracketing (AEB) that will do this automatically. Feature details vary by camera make and model.
- *Rectangular Angle Finder–viewfinder magnifier.* When using high magnification for extreme distance photography, a straight-through optical viewfinder magnifier is a useful accessory. A viewfinder magnifier enlarges the central area of the viewfinder image, which makes precise manual focusing easier. Viewfinder magnifiers were common in the days of manual focus lenses, but the development of auto-focus lenses diminished the need for viewfinder magnifiers and consumer demand declined accordingly. Today, Nikon offers such a product, but Canon does not. As a less than desirable alternative, but useful nevertheless, is the Rectangular Angle Finder offered by both Canon and Nikon. The Rectangular Angle Finder is an optical device that enlarges the central area of the viewfinder image, but for extreme distance photography, it is not as useful as a straight-through optical magnifier. It features a 90-degree angle and the prism system reduces the brightness of the image it provides. Nevertheless, it does work and aids accurate manual focusing. As any surveillance specialist doing extreme daytime and night vision photography will attest, accurate focusing is difficult when the scene lacks contrast, when the intensity of the viewfinder image is weak, when extraneous light makes seeing the viewfinder image difficult, and when the item requiring subject-specific focus is small in the viewfinder. Further frustrating the task of precise manual focusing is the fact that the focusing screen in most modern DSLR cameras is not ideal for manually focusing high-magnification lenses. Some DSLR cameras feature interchangeable focusing screens, some screens designed for precision manual focusing. Precise

manual focusing is easier when using a Rectangular Angle Finder and a focusing cloth to exclude extraneous light.

- *Focusing cloth.* Low-contrast scenes often lack something distinctive upon which to focus, with a dim viewfinder image exacerbating that situation. Four conditions usually contribute to a low intensity viewfinder image singly or in combination. The four conditions are low ambient light level, small aperture (slow) lens, diminished light transmission caused by tele-converters, and diminished effective f-ratio during afocal or eyepiece projection photography. An opaque cloth draped over the surveillance specialist's head and tripod mounted camera excludes extraneous light and makes critical focusing easier. Purchase a commercially available focusing cloth or make one using opaque cloth featuring the necessary color or camouflage pattern.
- *Adequate illumination.* Daytime illumination results in the best image quality, but surveillance specialists frequently photograph under low-light conditions. The only control the specialist has relative to low-level illumination is:
  - Move closer to the subject and use a shorter focal length fast lens.
  - Increase ISO to achieve a suitably fast shutter speed.
  - Underexpose to achieve a suitably fast shutter speed. Underexposure requires postprocessing of the images using a graphics-editing program. Shoot to RAW to avoid losing information.
  - Use a night vision device to increase the brightness of the image.
- *Timing.* Select the time photographing occurs, when possible. Usually that is not possible with human subjects because photographing occurs when and where subject activity occurs.
- *Vantage point.* Many issues influence the selection of a vantage point. This was discussed earlier under the subheading *Vantage Point Selection.*
- *Sharpest lens aperture.* Most telephoto lenses provide maximum resolution at approximately two to three f-stops below maximum aperture. Each surveillance specialist should perform resolution tests to determine the aperture at which each telephoto lens provides the *best* resolution. Use that aperture when maximum resolution is essential and low-level illumination does not require using maximum aperture. Photographers refer to the ideal aperture as being the lens's "sweet spot." When the lens's sweet spot is unknown, and lighting conditions permit, use an aperture two stops below maximum aperture. Having said this, realize that some modern lenses provide best resolution at maximum aperture. As Michael Covington explains, "Until about 1990, it was a rule of thumb that every lens performed best if you stopped it down a couple of stops from maximum aperture, but in this

modern era of ED glass and aspheric designs, some lenses are actually sharpest wide open" (Covington, 2007, p. 72, *Digital SLR Astrophotography*). When evaluating each telephoto lens to determine at what aperture best resolution occurs, the surveillance specialist need not be scientific. He or she can, if desired, photograph a resolution chart using controlled lighting, or simply hang a newspaper or magazine and photograph it at each aperture and scrutinize the resolution of each image.

- *Handhold properly.* When handholding the camera is necessary, hold it properly and have the image stabilization feature activated. Use the fastest shutter speed possible under the circumstances. When necessary, use high ISO and use a gyrostabilizer. Proper breathing is important.
- *Find ways to focus under low-light conditions.* In some instances, the nighttime illumination level is so low that auto-focus does not work and the viewfinder image is too dim for manual focusing. Previous discussion addressed ways to manage this situation.

Auto-Focus versus Manual Focus

The lenses for most digital single-lens reflex (DSLR) cameras and most camcorder lenses feature auto-focus (automatic focus). Auto-focus is a useful feature, but sometimes focusing manually is preferred or necessary. Focusing manually is necessary in the following circumstances.

- Circumstances are such that manual focus provides the best subject specific focus.
- Focus manually when auto-focus induced shutter lag may result in failure to record a fleeting moment of importance. Delayed shutter action can result in the so-called decisive moment being over before the shutter activates.
- When using a Canon or Nikon lens for afocal photography, focusing manually is necessary because no electrical connection exists between the lens and a digital single-lens reflex camera.
- When using telescopes for photography, manual focus is always necessary.
- Focusing manually is necessary when low-light levels render auto-focus inoperative or slow.

* During night vision photography, always focus manually.

Electronic First Shutter Curtain

The previously mentioned *electronic first shutter curtain* feature of a digital single-lens reflex (DSLR) camera exposes the image sensor electronically. The only mechanical action is the focal-plane shutter closing at the end of the exposure period. Canon refers to the electronic first shutter curtain as Silent Shooting with marketing emphasis on quiet operation of the camera, not vibration reduction. In fact, Canon instruction manuals for DSLR cameras with this feature make no mention of using it for the recording of vibration-free images.

In this book, the authors emphasize the importance of using the mirror lock-up feature of DSLR cameras when using a slow shutter speed or high-magnification optics, or both. Using the mirror lock-up feature with a remote shutter release eliminates vibration caused by the action of the reflex mirror when taking pictures. Nevertheless, the action of the focal-plane shutter and the drive motor causes some degree of image degrading vibration.

The recently introduced *electronic first shutter curtain* eliminates all mechanical action when taking a picture with a DSLR camera except for the rapid closing of the focal-plane shutter at the end of the exposure period. The result is enhanced image clarity. Canon and Nikon offer DSLR cameras featuring this technology.

The electronic first shutter curtain records images electronically without activation of the vibration-inducing focal-plane shutter and the electric motor that drives it. In this mode, the reflex mirror assumes the up position and the mechanical focal-plane shutter opens. Then, a sequential activation and deactivation of the sensor pixels records the image, the sensor exposed in a manner reminiscent of focal-plane shutter exposure.

A secondary value of the electronic first shutter curtain mode is the ability to view the image on the camera LCD monitor during focusing. Additionally, one can enlarge the image for an enhanced view when necessary. Readers who have a digital single-lens reflex camera featuring an electronic first shutter curtain are encouraged to experiment with it and compare telephoto results against those recorded using mirror-lockup. During low-light photography, do not permit the light from the LCD monitor to cause facial illumination.

MANIPULATING MAGNIFICATION AND F-RATIO

(Four Schmidt-Cassegrain Telescopes in One)

When using an f/6.3 focal-reducer and a 1.4x tele-converter together with a Schmidt-Cassegrain telescope, magnification decreases by approximately thirteen percent and the effective f-ratio increases by about 1/3-stop.)

When using the f/6.3 focal-reducer with a Schmidt-Cassegrain telescope (SCT), the effective focal length decreases and the f-ratio increases. When using a Canon or Nikon 1.4x tele-converter with an SCT, the effective focal length increases and the f-ratio decreases. Using the f/6.3 focal-reducer and 1.4x tele-converter together with an SCT splits the difference between each when used alone.

Stated at the beginning of this chapter, the surveillance specialist sometimes needs the means to manipulate the magnification of a Schmidt-Cassegrain telescope (SCT) according to the camera-to-subject distance. That is, the specialist needs the means to increase and decrease effective focal length. Similarly, the specialist sometimes needs the means to increase the effective f-ratio of an SCT in order to photograph under exceptionally low-light conditions, with or without an image intensifier night vision device.

When using either the highly versatile SCT-Configured AstroScope or the less versatile Special-Order Battery-Adapted AstroScope with a Schmidt-Cassegrain telescope the specialist manipulates focal length and f-ratio using an f/6.3 focal-reducer and a Canon or Nikon 1.4x tele-converter, singly or in combination (refer ahead to Figures 4-63 and 4-64 and refer to Figure 5-23 in Chapter 5).

The telescope manufacturers Celestron and Meade Instruments Corporation each provide an f/6.3 focal-reducer intended for specific SCT applications. Similarly, Canon and Nikon provide tele-converters intended for specific applications. When used as intended by the manufacturers, focal-reducers and tele-converters change the magnification and f-ratio of the host lens to the extent that their rating specifies. For example, the Celestron and Meade f/6.3 focal-reducers decrease the focal length of an SCT by 37 percent and increase the effective f-ratio by 1 1/3 stops. The Canon and Nikon 1.4x tele-converters increase the effective focal length of the host lens by 40 percent and reduce the effective f-ratio by one stop. Using an f/6.3 focal-reducer and a 1.4x tele-converter together with a Schmidt-Cassegrain telescope (SCT) results in a magnification reduction of approximately 13 percent and an f-ratio gain of 1/3 stop.

The engineers at Celestron and Meade Instruments Corporation never envisioned people using their f/6.3 focal-reducer with an AstroScope Night Vision Module. Similarly, engineers at Canon and Nikon never envisioned photographers using their 1.4x tele-converters with a Schmidt-Cassegrain telescope or an AstroScope Night Vision Module. Certainly, in their wildest imagination, none of the manufacturers envisioned somebody using a focal-reducer and tele-converter at the same time. Photographers in other genre would not do that. However, the clandestine photographer is committed to recording usable photographic images under diverse field conditions and will do whatever is required to accomplish that without regard for how outrageous a method may appear to other photographers. If a technique works, the clandestine photographer will use it.

When using a focal-reducer and tele-converter in the unorthodox ways discussed here and elsewhere in this book, the question begging an answer is whether they modify magnification and f-ratio to an extent consistent with the rating of each device. That is, do the f/6.3 focal-reducer and 1.4x tele-converter cause a greater or lesser change to magnification and f-ratio than the manufacturers intended? Field-testing confirmed that when using them with an SCT, singly or together, they modify magnification and effective f-ratio as the manufacturers intended. Miniscule deviations found during field-testing were likely the result of the fact that the focal length and f-ratio of an SCT varies somewhat throughout the focusing range.

The surveillance specialist recorded the following comparative images using the 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope with the Canon EOS 30D digital single-lens reflex crop-sensor camera. In all instances, the truck and camera remained in one position; camera-to-subject distance and perspective is the same for each image (see Figures 4-63 and 4-64). When comparing the high ISO available light images with the night vision images recorded using the Special-Order Battery-Adapted AstroScope Night Vision Module, be aware that the AstroScope features a 1.6x conversion factor. That is why the night vision images are larger than the images recorded without the AstroScope.

Stated previously, these two sets of images illustrate the effect that the AstroScope 1.6x conversion factor has on image size. The standard AstroScope (custom AstroScope in this instance) creates a cropped image, something to remember during the presurveillance survey (reconnaissance) when considering lens magnification requirements.

When using an f/6.3 focal-reducer and 1.4x tele-converter together, multiply the focal length and f-ratio of the SCT by 0.882 to obtain effective focal length and f-ratio (e.g., 1500mm f/10 x 0.882 = 1320mm f/8.82).

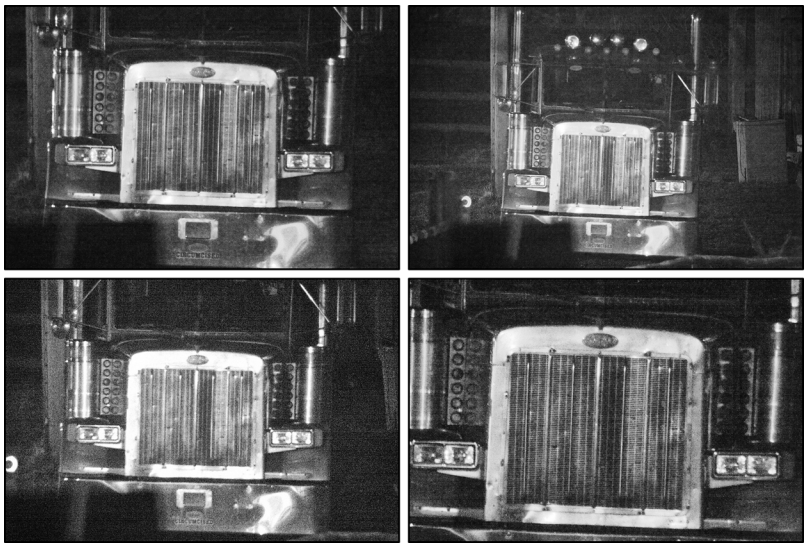

Figure 4-63. Nighttime available light images recorded using the Canon EOS 30D digital single-lens reflex (DSLR) crop-sensor camera at ISO 3200 with the 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope (SCT) by means of the direct coupling (prime focus) method. Camera-to-vehicle distance is 224.09 meters (245 yards). Long-range photography using a high-magnification SCT sometimes requires the ability to increase or decrease magnification according to camera-to-subject distance. Sometimes the surveillance specialist needs more magnification, but at other times, reducing magnification is necessary to increase field-of-view. *Upper left image:* Image recorded without either a focal-reducer or a tele-converter. 1500mm f/10. *Upper right image:* Image recorded using the f/6.3 focal-reducer. 945mm f/6.3. *Lower left image:* Image recorded using the f/6.3 focal-reducer and Canon 1.4x tele-converter together. 1323mm f/8.82. *Lower right image:* Image recorded using the Canon 1.4x tele-converter. 2100mm f/14.

Calculating Exact Focal Length

If it is ever forensically important to know the exact focal length, measure it rather than calculate it. Michael Covington explains the simplest way to accomplish this:

> Focal length = Object distance * (Image size / true size)
>
> Suppose you photograph a license plate that is 300 mm wide, and it makes an image that is 3 mm wide on the sensor or film, and it is 200 meters (200,000 mm) away. Then:
>
> Focal length = 200,000 * (3 / 300) = 2000 mm

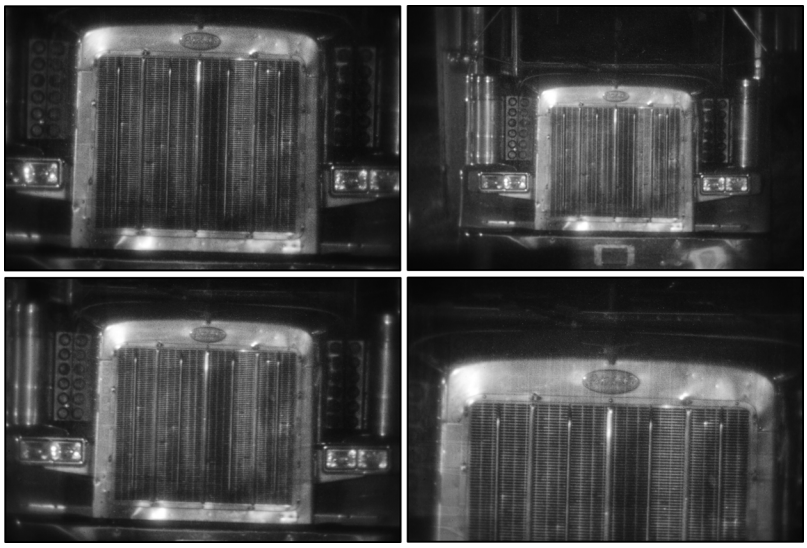

Figure 4-64. Night vision images recorded using the Canon EOS 30D digital single-lens reflex (DSLR) crop-sensor camera at ISO 100, 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope (SCT), and Special-Order Battery-Adapted AstroScope. Camera-to-vehicle distance is 224.09 meters (245 yards). Long-range photography using an image intensifier night vision device requires the ability to manipulate magnification; the image must be as large as possible in the frame without field-of-view diminishing to an unacceptable extent. *Upper left image:* Image recorded without a focal-reducer or a tele-converter. 1500mm f/10. *Upper right image:* Image recorded using the f/6.3 focal-reducer. 945mm f/6.3. *Lower left image:* Image recorded using the f/6.3 focal-reducer and Canon 1.4x tele-converter together. 1323mm f/8.82. *Lower right image:* Image recorded using the Canon 1.4x tele-converter. 2100mm f/14.

> That's all you need! Just make sure all the numbers are in millimeters. And of course, you have to know how many pixels there are per millimeter on your sensor, so you can judge the sensor image size. Or substitute a film camera and measure the image on the film. (Michael Covington, personal communication, March 7, 2011)

Chapter 5

NIGHT VISION PHOTOGRAPHY FOR CLANDESTINE OPERATIONS

PREFACE

The author's quest to find methods for recording nighttime photographic images from extreme distances using image intensifier night vision devices (NVDs) was successful. They increased the inadequate standoff distance of about 274 meters (300 yards) to over 1,030 meters (1,126 yards/0.64 mile). Refer ahead to Figures 5-26 and 5-39. From those distances, they successfully recorded recognizable images of human subjects and legible vehicle number plates (license plates).

Considering the distances and field conditions under which they recorded the images, the equipment and methods used, and knowing what equipment and refined methods are available, there is basis upon which to believe the mathematic computations suggesting that recording such detail from distances exceeding 1.61 kilometers (1 mile) is possible.

INTRODUCTION

At the time of this writing, two recent technologies have revolutionized night vision photography and videography. They are the AstroScope models configured for SCT-based extreme distance photography and digital single-lens reflex cameras featuring Full HD movie mode with manual exposure control. SCT is an initialization for Schmidt-Cassegrain telescope.

Night vision photography is the recording of photographic images at night using an image intensifier night vision device (NVD) to increase image brightness. Unfortunately, too often, a surveillance specialist acquires an NVD, couples it with a camera or camcorder, records some nighttime im-

ages, and finds image quality disappointing. Night vision photography involves more than simply mounting an NVD to a camera or camcorder and recording images in the usual manner. The information in this chapter will help surveillance specialists record the best quality images possible when photographing with an image intensifier NVD.

Not everybody engaged in image intensification night vision photography or videography do so for investigative or intelligence purposes. For example, news agencies record night vision images to support news reports. Scientists use night vision photography during nocturnal nature studies. Aside from intelligence gathering, the military uses night vision photography during training exercises for later critique, to create images for training purposes, to accumulate public relations images, and to acquire images to support or refute propaganda.

Nonclandestine night vision photography differs from clandestine applications in several ways. Nonclandestine applications usually involve photographing a relatively large generalized area from a short distance using a low-magnification large aperture (fast) wide field lens. In most instances, no need for secrecy exists and for that reason, human subjects usually are aware that photographing is occurring. Conversely, clandestine applications usually involve photographing a limited subject-specific area from a long distance using a high-magnification small aperture (slow) narrow field lens. Maintaining operational secrecy is essential and for that reason, human subjects are unaware that photographing is occurring.

In comparison to photographic images recorded during daylight hours, image intensifier NVDs provide low-resolution images, image detail being comparable to that of a three megapixel digital camera. That being the case, recording detail such as subject identification (i.e., facial recognition) and legible vehicle number plates requires that the subject fill a large portion of the frame, which results in an unforgiving situation relative to magnification. Too little magnification results in failure to record essential detail and even slightly more magnification than necessary can cause inadequate field-of-view.

Because the degree of magnification is critical during long-range night vision photography, the surveillance specialist needs the means to manipulate magnification (and f-ratio) and therein is the reason for using the f/6.3 focal-reducer and Canon or Nikon tele-converters with Schmidt-Cassegrain telescopes (SCTs). This is also the reason why the specialist favors the traditional SCT over flat-field Catadioptric telescopes such as the Celestron EdgeHD Schmidt telescopes and Meade LX200-ACF Series telescopes that provide a flat focal plane all the way to the edge of the field-of-view. These latter telescopes are not compatible with the f/6.3 focal-reducer because, being a field-flattener the focal-reducer causes curvature to the flat field of

the telescopes. Chapter 2, under the subheading *F/6.3 Focal-Reducer and Flat Field Catadioptric Telescopes,* provides additional information about this incompatibility. For clandestine applications, using an f/6.3 focal-reducer with flat field telescopes may be permissible (this potential begs experimentation).

In addition to the degree of magnification being a critical issue, the surveillance specialist must manage difficult atmospheric conditions when photographing from long distances. Moreover, the specialist must understand characteristics unique to image intensifier night vision photography because it is very unforgiving.

Most of the night vision images appearing in this chapter are images the authors recorded under less than ideal nighttime lighting and atmospheric conditions. The reason for selecting such images is to illustrate what is typical, to illustrate the degree of image quality to expect during real-life in-field surveillance operations. The unfortunate reality is that ideal nighttime lighting and atmospheric conditions rarely exist during long-range photographic surveillance. Seldom does a full moon and clear star-filled sky exist. Rather, night vision photography usually occurs under an illumination level somewhere between good and bad.

This chapter provides the most comprehensive discourse available on the topic of image intensifier night vision photography. It addresses conventional methods of night vision photography and it addresses advanced long-range methods. After reading this chapter, readers will understand the potentials and limitations of night vision photography. They will know what is possible and what is not possible. They will understand what to do, how to do it, and why doing things in a certain manner is necessary. They will understand how to configure digital single-lens reflex cameras, digital pocket cameras, and camcorders with image intensifier night vision devices for ease and efficiency of operation. The reader will know the pros and cons of the various night-vision photography systems.

When work on this book began, surveillance specialists needed image intensifier night vision photography, but existing products provided a limited standoff capability. A night vision system configured for long-range photography did not exist and neither did long-range methods exist. Standoff distance was so limited that keeping a clandestine photography operation secret was difficult. Worse, field personnel could not photograph from a safe distance; plainclothes personnel must preserve anonymity and some subjects are dangerous! Available equipment permitted recording detail such as recognizable images of human subjects and legible vehicle number plates from little more than 274 meters (300 yards). Maximum camera-to-subject distance varied by system but in all instances, standoff distance was inadequate.

Because night vision photography is essential for clandestine operations but maximum range was insufficient, the authors began seeking ways to increase the standoff capability. Driven by the belief that where there is a will, there is a way, they found two methods that permit photographically recording night vision images from extreme distances. That is, recording recognizable images of human subjects and legible vehicle number plates.

First, they successfully combined methods of astrophotography and conventional terrestrial photography for photographing with an image intensifier night vision monocular (refer ahead to Figures 5-36, 5-37, 5-38, and 5-43). The hybrid methods are very effective and they provide considerable versatility. The methods permit doing things that are possible no other way, but they require a high level of technical expertise. Second, they determined that modifying the standard AstroScope Night Vision Module would permit using it with any size high-magnification Schmidt-Cassegrain telescope from extreme distances[1] (refer ahead to Figures 5-17 and 5-23). The AstroScope, designed specifically for photography, is very user-friendly and therefore requires considerably less technical expertise than the hybrid methods require.

Once determining that modification of the standard AstroScope would permit using it with high-magnification Schmidt-Cassegrain telescopes (SCTs) for extreme distance photography, and ascertaining the nature of the required modification, the authors communicated their hypothesis to the manufacturer. After discussing details, the manufacturer modified the author's AstroScope in the manner requested so that it would work with Schmidt-Cassegrain telescopes (SCTs).

Field tests using the custom AstroScope produced convincing results. It performed well with high-magnification SCTs for extreme-distance night vision photography. The authors recorded the initial series of test photographs from distances ranging between 0.43 and 0.87 kilometer (0.27 and 0.54 mile).

With good performance of the custom AstroScope confirmed, the manufacturer decided to offer it as the *Special-Order Battery-Adapted AstroScope.* Additionally, the manufacturer began designing the *SCT-Configured AstroScope* that will be in the form of a new telescope Front Lens Adapter (FLA) attachment to join the family of standard AstroScope components.

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1. The custom AstroScope that the authors use and illustrate in this chapter is their brainchild, their creative conception. At their request, the manufacturer modified their standard AstroScope to perform with nonelectronic lenses (i.e., refracting telescopes and high-magnification Schmidt-Cassegrain telescopes). The custom AstroScope is a one-of-a-kind model, a prototype and predecessor of the Special-Order Battery-Adapted AstroScope that the manufacturer now offers on a special order basis. Hereafter, the authors refer to their custom AstroScope as a Special-Order Battery-Adapted AstroScope because they are the same product. Development of the versatile SCT-Configured AstroScope is the manufacturer's innovation inspired by the impressive performance of the custom AstroScope.

At the time of this writing, development of the SCT-Configured AstroScope is in the bench-testing phase to work out design details. Once introduced to the commercial market, the actual names of the new models may differ from the names used here (e.g., *SCT-Configured AstroScope* and *Special-Order Battery-Adapted AstroScope*). Nevertheless, the names will be sufficiently descriptive that no confusion will result when viewing them at the websites of the manufacturer and their United States distributor, Morovision Night Vision, Inc.

Because these AstroScope models will reach the marketplace before this book does, and for ease of writing, this chapter treats them as existing products. Additionally, previously stated, because no significant difference exists between the author's custom AstroScope and the Special-Order Battery-Adapted AstroScope, subsequent discussion refers to it as a Special-Order Battery-Adapted AstroScope. That will minimize confusion.

These specialized AstroScopes configured for SCT-based extreme-distance night vision photography provide the same light amplification advantage that characterizes standard AstroScope models. That is, they amplify existing illumination by approximately 40,000 times. The manufacturer explains that, "Light amplification is equivalent to an 8-10 F-stop improvement so that moonlit or starlit scenes are transformed into bright images" (Sofradir EC, Inc. 2011, n.p., *AstroScope for Canon [and Nikon] SLR Cameras*).

Another achievement during the writing of this book was finding methods to eliminate the time on each end of the day, morning and evening, when manual clandestine photography was impossible. Twice a day photographing was not possible because it was too dark for high ISO available light photography but too light to photograph using an image intensifier night vision device. Now, there is no time during the day that manual clandestine photography cannot occur. Similarly, the level of artificial nighttime illumination is sometimes such that it is too low for high ISO available light photography but too bright for night vision photography. That, now, is a manageable situation.

Developing methods for extreme distance photography using an image intensifier night vision device created other needs that did not exist when standoff distance was limited. Unlike before, surveillance specialists now need the following:

- Long-range infrared (IR) illuminators.
- A night-vision finder scope. High magnification results in field-of-view being so limited that locating a distant subject quickly requires using an image intensifier night-vision finder scope. A night vision weapon sight mounted to the optical system works well as a finder scope (refer ahead to Figure 5-17.

- Neutral density (ND) filters are necessary in some instances to reduce the level of illumination reaching the faceplate of the intensifier tube of the night vision device. ND filters feature uniform density and therefore they reduce the brightness level of all colors equally. The use of ND filters is necessary in the following circumstances.
  - Artificial illumination in the subject vicinity is inadequate for high ISO available light photography but too bright to use an image intensifier night vision device. Using an ND filter to reduce the level of incoming light permits night vision photography.
  - During morning and evening when it is too dark for high ISO available light photography yet too light to use an image intensifier night vision device, an ND filter will permit night vision photography by reducing the level of incoming light.
- The means to increase the effective f-ratio (aperture/speed) of a high-magnification optical system such as a Schmidt-Cassegrain telescope (SCT) has become necessary. Increasing effective f-ratio is sometimes necessary for the following reasons:
  - To photograph in the passive mode under low-light conditions that otherwise would require going active by using an infrared (IR) illuminator.
  - To increase the brightness of the image reaching the faceplate of the intensifier tube of the night vision device to improve image quality by minimizing Automatic Brightness Control (automatic intensifier tube gain). Reducing tube gain reduces scintillation, which improves image quality.
  - To increase the brightness of the image reaching the faceplate of the intensifier tube of the night vision device as a means to increase shutter speed. Nevertheless, shutter speed will not increase by an amount equal to the increased brightness of the light reaching the intensifier tube. That is because the automatic gain control feature of intensifier tubes increase and decrease tube gain according to the level of illumination reaching the faceplate, doing that to maintain a constant output (i.e., keep the brightness of the green phosphor screen image reasonably constant irrespective of the level of incoming illumination).

Doing quality night vision photography from extreme distances and under diverse lighting conditions requires that the surveillance specialist understand how image intensifier night vision devices (NVDs) perform under various low-light conditions. Additionally, the specialist must understand how the dynamics of the NVD interact with those of the digital camera under var-

ious lighting conditions. The specialist must understand the affect that camera ISO, the level of NVD manual variable gain, and Automatic Brightness Control (automatic intensifier tube gain) have on image quality. Manual variable gain is a feature that the operator manually adjusts. It is independent of the automatic intensifier tube gain that keeps the intensifier's light output constant, this issue discussed shortly.

The level of nighttime illumination significantly affects the quality of photographic images recorded using an image intensifier night vision device. Unfortunately, the surveillance specialist seldom photographs under ideal nighttime lighting conditions. Lighting varies from a full moon starlit sky to an overcast sky devoid of moonlight and starlight. Usually, the specialist does night vision photography under an illumination level somewhere between those two extremes. The moon, for example, is full only once a month.[2] Fortunately, those working in urban areas often benefit from artificial illumination in the subject's vicinity, although the direction of illumination is important.

Numerous variables make photography using an image intensifier night vision device (NVD) challenging, especially when photographing from extreme distances. For example, when photographing from distances exceeding 0.40 kilometer (0.25 mile), whether during daylight hours or at night using an image intensifier NVD, the atmosphere presents a challenge. Image degrading near ground thermals (i.e., heat waves/convection currents) and general atmospheric turbulence exists during the day and at night.

The information that this chapter provides will leave readers aware of the capabilities and limitations of image intensifier NVDs for photography, previously stated. That understanding will help field personnel who use the equipment and it will help those responsible for equipment procurement. Obtaining procurement authorization is easier when showing that a purchase is an investment rather than expenditure.

ITT Night Vision, located in Roanoke, Virginia (USA), "is the world's leading developer, producer and supplier of Generation 3 image intensifier technology for military and all levels of law enforcement" (ITT Night Vision, 2009, n.p.–*About ITT Night Vision*). In the United States, Morovision Night

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2. Addressing the question *How often is there a full moon?,* Ask.com (2010, n.p.) explains that, "A full moon occurs every 29.53 days, which is the length of the lunar month. Although some people think a full moon only lasts one night, the moon is continually growing and waning so the full moon period can last 2 or 3 days." Regarding *Moon Phases,* The University of Texas McDonald Observatory (2011, n.p.) explains that, "The Moon has phases because it orbits Earth, which causes the portion we see illuminated to change. The Moon takes 27.3 days to orbit Earth, but the lunar phase cycle (from new Moon to new Moon) is 29.5 days. The Moon spends the extra 2.2 days 'catching up' because Earth travels about 45 million miles around the Sun during the time the Moon completes one orbit around Earth."

Vision, Inc.[3] is the authorized U.S. Law Enforcement Distributor for ITT Night Vision and the ITT Night Enforcer® product line. Morovision is also a distributor for Sofradir EC, Inc., manufacturer of the AstroScope Night Vision Module system. In Canada, the Current Corporation, Law Enforcement Division,[4] is the exclusive distributor for ITT Night Vision products.

It is unfortunate that so few United States law enforcement agencies use image intensifier night vision devices (NVDs), considering what the technology offers. True, budget is a legitimate concern, but, arguably, American law enforcement should be on the cutting edge of technology. The hope is that the information this chapter provides will contribute to more law enforcement agencies acquiring image intensifier night vision devices and developing a strong night vision photography capability. Morovision Night Vision, Inc. reports the unfortunate fact that:

> . . . the majority of law enforcement officers, particularly those serving small to mid-sized populations, do not have access to night vision. . . . According to the Law Enforcement Management and Administrative Statistics (LEMAS), there are more than 18,750 police departments in the United States. While most departments have surveillance camera equipment, the majority does not have night vision, infrared or thermal imagers. Of the 49 state agencies surveyed: 12 have night vision equipment [and] 24 have infrared or thermal imagers. (Morovision Night Vision, Inc., 2010, n.p., *ITT Night Vision Case Studies*)

This chapter provides an overview of image intensifier night vision technology and it presents basic and advanced night vision photography methods. Aside from the AstroScope models configured for SCT-based extreme distance photography, the methods for long-range night vision photography are a hybrid of astrophotography and traditional terrestrial photography techniques, previously stated. Therefore, the person with astrophotography experience enjoys an enviable advantage. Nevertheless, they must understand the idiosyncrasies of image intensifier night vision devices and recognize the numerous variables they must manage when engaged in long-range night vision photography, which is terrestrial photography. The variables, as stated, exist during daylight hours and at night, most notably image degrading near-ground thermals and atmospheric turbulence.

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INFRARED THERMAL IMAGERS AND IMAGE INTENSIFIER NIGHT VISION DEVICES

Doing night vision photography from beyond the detection range of most binoculars and image intensifier night vision devices is possible. Unfortunately, photographing from beyond the detection range of handheld infrared thermal imagers is not possible. Nevertheless, possibilities exist for photographing under such a circumstance.

Introduction

The surveillance specialist must be aware of two types of night vision technology. They are infrared thermal imaging and light amplification, the latter also referred to as image enhancement and image intensification. This text uses the terms image intensification and image intensifier. The two technologies are very different with each providing essential benefits that the other cannot provide.

For clandestine photography during physical surveillance, the surveillance specialist uses image intensification, not infrared thermal imaging. When using infrared thermal imaging during a photographic surveillance operation it is for applications such as security, not photography.

Infrared Thermal Imaging

Commercial handheld thermal imagers have a human detection range as great as 2.5 kilometers (1.55 miles). Military handheld thermal imagers have a human detection range as great as 14.48 kilometers (9 miles). Vehicle mounted thermal imagers used by the military have a human detection range as great as 40.23 kilometers (25 miles). (FLIR Systems, Inc., personal communication, October 13, 2010)

For the recording of photographic images, the surveillance specialist uses an image intensifier night vision device not an infrared thermal imager. Understanding the difference between the two technologies is important. Under the title *The Importance of Sight at Night,* Morovision Night Vision, Inc. (2010, n.p.) explains that, "While [police] officers sometimes refer to thermal imaging (heat detection) as night vision, the term night vision generally refers to image intensification (light amplification)."

Infrared thermal imaging, hereafter referred to as thermal imaging, works during the day and at night. People and objects are detectable by means of thermal imaging when they are warmer or cooler than the background, and when they are within detection range. Detection in the rural environment by means of thermal imaging is a risk that the surveillance specialist must con-

sider. Although a subject using thermal imaging can detect a surveillance team in a densely populated urban area, circumstances can leave the subject dismissing the team as innocuous members of the local human population. Such dismissal is unlikely in the sparsely populated rural environment.

For the recording of photographic images, the surveillance specialist uses an image intensifier not a thermal imager, previously stated. That is because thermal imagers do not provide the required image detail. Thermal imagers provide clarity sufficient to distinguish between people, animals, and objects, but resolution is not sufficient to record detail such as subject identification (i.e., facial recognition) or legible vehicle number plates.

Image intensifier night vision devices amplify reflected radiation (light) in the visible and near infrared region of the electromagnetic spectrum. Thermal imagers respond to the wavelengths of thermal-infrared (heat) in the range of 3–30+ microns. Under the heading, *How Thermal Imaging Works,* Morovision Night Vision, Inc. (2008, n.p.), explains that, "Most thermal imaging devices . . . sense temperatures ranging from -4 degrees Fahrenheit to 3,600 degrees Fahrenheit [-20 degrees Celsius to 2,000 degrees Celsius], and can normally detect changes in temperature of about 0.4 degrees Fahrenheit [0.2 degrees Celsius]."

The observer and protective personnel assigned to a rural clandestine photography team should use both an image intensifier (light amplification) night vision device and thermal imager (heat detection) for defensive purposes. In virtually all atmospheric conditions such as smoke, fog, rain, snow, and extreme darkness, a thermal imager will usually detect the presence of unfriendly personnel. Relative to working in extreme darkness, under the heading *How Thermal Imaging Works,* Morovision Night Vision, Inc. (2010, n.p.) explains that, "Unlike traditional . . . night vision equipment which uses image-enhancement technology, thermal imaging is great for detecting people or working in near-absolute darkness with little or no ambient lighting (i.e. stars, moonlight, etc.)."

Unfortunately, some adversaries use image intensifier night vision devices and thermal imagers for countersurveillance. The extreme-distance night vision photography methods provided in this chapter will not place the photography team beyond the detection range of even a commercial handheld thermal imager. Stated earlier, it is important to realize that thermal imagers work at night and during daylight hours. Always, during planning, attempt to determine the subject's countersurveillance capability.

A representative of FLIR Systems, Inc. confirmed that most commercial handheld thermal imagers are capable of detecting a clandestine photography team from a distance as great as 2.5 kilometers (1.55 miles). A rural clandestine photography team doing night vision photography from a distance of

1.61 kilometers (1.0 mile), for example, is beyond the *recognition* range but within the *detection* range of a commercial handheld thermal imager. At the detection range, the subject will not know what he or she detected but will know that something or somebody is in the area. Likely, the subject will investigate. Previously stated, military handheld thermal imagers have a human detection range as great as 14.48 kilometers (9 miles). Vehicle-mounted thermal imagers used by the military have a human detection range as great as 40.23 kilometers (25 miles).

When a subject uses thermal imaging for countersurveillance, day or night, the photography team cannot get close enough to photograph that subject without undue risk of detection. Nevertheless, possibilities exist for photographing under such a circumstance. During a safe period, clandestinely secret a camera near the subject and operate it electronically from beyond the detection range of the thermal imager. That, of course, requires determining what model thermal imager the subject uses. Alternatively, remotely operate the camera from a human occupied location that will not generate suspicion. Another possibility is to conduct high-magnification hands-on photographic surveillance from a location where unrelated human activity is expected. In these latter instances, although the subject can detect the presence of the photography team suspicion may not result. Rather, the subject may dismiss the team as being innocuous members of the environment, depending, of course, on the nature of the location and the time that detection occurs. Detecting a team at 9:00 p.m. may not generate suspicion, but detection at 3:00 a.m. may result in an investigative response.

Image Intensifier Night Vision Device

> Image intensification is the most popular technology for Night Vision today. Devices based on image intensifiers include night vision goggles, pocketscopes and night vision modules for photography and videography. At the heart of these devices is an image intensifier that amplifies the available light resulting in bright green images of low-light scenes. (Sofradir EC, Inc., 2010, n.p., *Image Intensifiers*)

Image intensifier night vision devices (NVDs) permit visual observation and photography under low-light conditions by intensifying light, by converting low light to bright light. Simply stated, "Image intensifiers capture ambient light and amplify it thousands of times by electronic means. . . . The main advantages of image intensifiers as Night Vision Devices are their small size, light weight, low power requirements and low cost" (U.S. Army Research, Development and Engineering Command, 2008, September 15, n.p., *Image Intensification*).

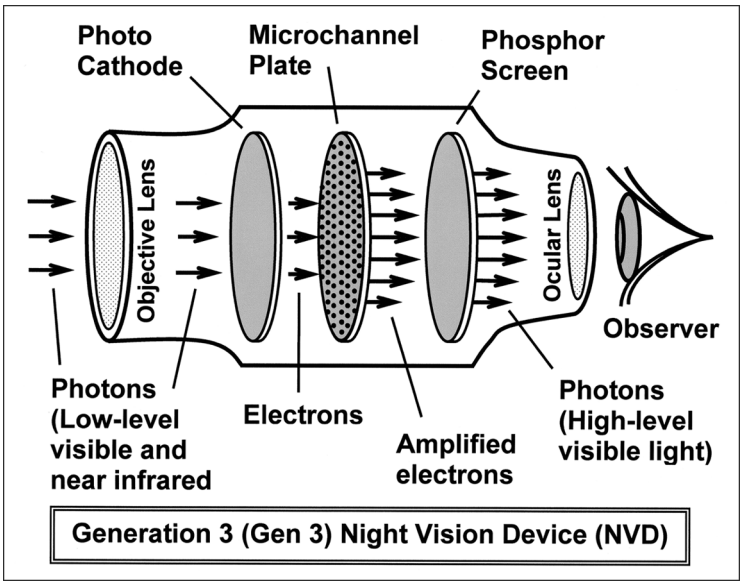

Figure 5-1. Visible light and the near infrared frequencies entering the image intensifier tube of a night vision device (NVD) pass through a photo cathode that converts the visible light into electrons. The electrons then pass through a microchannel plate for multiplication thousands of times after which they collide with the phosphor screen causing it to exhibit luminescence, which is the visible image. The photons emitted by the phosphor screen provide the intensified visible image that the observer sees and that the camera or camcorder records. NVDs feature a black and green image because the human eye differentiates more shades of green than any other color.

Image intensifier night vision devices (NVDs) feature a front objective lens and a back eyepiece lens. Between the two is an *image intensifier tube.* The intensifier tube amplifies light by taking low-level ambient light and converting the weak photons (light energy) into electrons (electrical energy). After undergoing multiplication, the electrons create a visible image on a phosphor screen. It is the image on the phosphor screen that the observer views and the surveillance specialist photographs (see Figure 5-1).

The phosphor screen of an image intensifier night vision device is green for a reason. Morovision Night Vision, Inc. explains that, "Night Vision is deliberately green in color as shading levels in green are the easiest for the human eye to distinguish. Night Vision used to be available in red, but scientists later determined that green was easier to see and use" (Morovision Night Vision, Inc., 2010, n.p., *Why Is Night Vision Green?*).

Although various specialized image intensifier night vision devices (NVDs) exist, handheld direct-viewing models are available in the form of a

monocular, biocular, and binocular. The binocular features twin intensifier tubes while the biocular and monocular models feature a single intensifier tube (see Figure 5-2). Many monocular models are camera adaptable.

For direct viewing, the twin intensifier tube binocular outperforms the single tube biocular and monocular by providing a brighter image and a stereoscopic view. A side-by-side comparison of a twin tube binocular and single tube monocular reveals a conspicuous performance difference. Cyrus M. Smith (2001, September, p. 37) explains that a comparative analysis of night vision devices "concluded that a binocular night vision device is best under all circumstances and that a biocular and monocular device are about the same."

Almost without exception, regardless of brand, the image intensifier night vision monocular (NVM) is camera adaptable by means of an appropriate adapter. The Camera Adapter Assembly provided by ITT Night Vision for the PVS-14 series NVD permits screwing the NVD to the camera filter threads (refer ahead to Figure 5-41). In addition to the Camera Adapter Assembly, photographing efficiently requires using an in-house fabricated mounting platform (refer ahead to Figure 5-35 and refer to Figure 3-20 in Chapter 3).

Some image intensifier NVDs accept auxiliary extension magnification lenses (refer ahead to Figure 5-13 and refer to Figure 3-20 in Chapter 3). Optically, extension magnification lenses are small Galilean afocal telescopes. ITT Night Vision manufactures a Mil-Spec (military specifications) f/1.5 3x and an f/2.4 5x extension magnification lens for their PVS-14 series night vision monocular and for single tube biocular models. Some double tube binocular models also accept extension magnification lenses.

Some night vision devices feature manual variable gain control and some do not. The ITT NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device illustrated above features manual variable gain control. The twin intensifier tube night vision binocular, illustrated above, does not feature manual variable gain control. Nevertheless, they both feature Automatic Brightness Control (ABC), also referred to as automatic intensifier tube gain.

Modern intensifier tubes feature Automatic Brightness Control, a feature that automatically increases and decreases gain according to the level of ambient illumination, doing that to maintain a constant output. Automatic Brightness Control keeps the brightness of the green phosphor screen between 2.5–5 foot candles to prevent the viewer suffering eye injury should exposure to bright light occur. As ambient illumination increases, the intensifier tube gain/output automatically decreases. As ambient illumination decreases, the intensifier tube gain/output automatically increases. That is why on a very dark night the image provided by modern intensifier tubes exhibits increased scintillation (electronic noise/grain) and consequently reduced image quality (refer ahead to Figures 5-24 and 5-26 and compare their quality).

Figure 5-2. Image intensifier night vision devices (NVDs) designed for direct viewing are available in the form of a binocular, biocular, and monocular with many monocular models being camera adaptable. Moreover, many NVD models accept extension magnification lenses. *Upper image:* BNVS M953 (AN/PVS-15 Style) Binocular Gen 3 viewed from the eyepiece end with the eyecups removed. The ample diameter of the eyepieces makes finding and holding the sight picture quick and easy during fast moving situations. The AN/PVS-15 is a twin intensifier tube night vision binocular based on the military DoD nomenclature AN/PVS-15 used by U.S. special forces. Users can handhold or helmet mount this binocular. *Lower left image:* PVS-7 Goggle Gen 3 PINNACLE® (PVS-7B/D type). This single intensifier tube night vision biocular (goggle) manufactured by Morovision Night Vision, Inc. is the standard issue goggle type supplied to the U.S. Military and its allies. Users can handhold, head mount, or helmet mount this biocular. *Lower right image:* NEPVS-14 Night Enforcer® Gen 3 PINNACLE monocular night vision device. Users can handhold, head mount, helmet mount or camera adapt this monocular.

GENERATIONS OF NIGHT VISION DEVICES

The night vision device (NVD) first appeared during World War II and evolved through technological generations. Night vision began with Generation 0 (metascopes) and evolved to what is now, at the time of this writing, generation 3 image intensifier night vision devices (see Table 5-1).

Contrary to some misleading marketing claims, at the time of this writing, there are no fourth generation (Gen 4) image intensifier night vision devices (NVDs). Morovision Night Vision, Inc. explains this as follows:

> Generation 4–Myth versus Fact. Some say that generation (Gen) 4 is the most advanced night vision you can buy. *This is not the case.* To dispel this myth, let's start with the basics. There are four Generations of night vision; however, they are Gen 0-3, not Gen 1-4. Historically, the U.S. Army has defined each Generation of night vision. In the late 90's the Army did define Gen 4 as the removal of the ion barrier film creating a "filmless" tube. This new advancement was to reduce halos while increasing sensitivity, signal-to-noise ratio (SNR) and resolution, for overall improved performance. While performance was improved, the lack of an ion barrier in Gen 4 tubes led to high failure rates, ultimately leading the U.S. Army to recant the existence of Gen 4 definition. Recognizing the high failure rates of Gen 4 tubes, ITT chose to improve upon the existing Gen 3 technology and create a "thin-filmed" tube. By keeping the protective ion barrier, but greatly reducing its thickness, ITT was able to maintain the reliability of Gen 3 while–at the same time–delivering on the Army's performance requirements intended for Gen 4. This innovation resulted in the production of the Gen 3 thin-filmed tube, which is now the highest performing Gen 3 tube available. Not long after, the gated power supply was added and the PINNACLE® tube was born. The Generation 3 PINNACLE® tube is the most advanced night vision manufactured to date. (Morovision Night Vision, Inc, 2010, n.p.–*Myth vs. Fact: Generation 4*)

The cost difference between Gen 1, 2, and 3 image intensifier night vision devices (NVDs) is considerable. Some people may question if the price of a Gen 3 NVD is justified when they can purchase a Gen 2+ NVD for two-thirds the cost or purchase a Gen 1 NVD for one-tenth the cost. The price of a high quality Gen 3 NVD is justified; the price represents good value! For professional applications, especially for photography, use only high quality Gen 3 NVDs or whatever improved version the future presents (see Figures 5-3 and 5-4).

Table 5-1.
NIGHT VISION DEVICE SPECIFICATIONS BY GENERATION

The following information is approximations–performance varies by manufacturer, product model, and periodic product improvement.					
Generation	0	1	2	2+	3
Tube type	S-1 silver shifted cesium oxide Anode cone P1 phosphor screen.	Photocathode and electrostatic inversion achieves gain.	S-20 (extended red) photocathode. Microchannel plate to achieve gain. P-10-52 phosphor screen.	S-20R (redshift) photocathode. Increasing image tube bias improved gain. A glass faceplate improved resolution. P-22 phosphor screen.	GA (Gallium Arsenide) photocathode. Microchannel plate to achieve gain. GaAs photocathode.
Spectral response			400 nm to 850 nm	400 nm to 850 nm	450 nm to 950 nm
Gain (Brightness or luminance gain, amplification, photo-response)	No gain Infrared (IR) illuminator required	1,000x	20,000x	22,000x	40,000x
Resolution (lp/mm)		25–30 lp/mm*	24 lp/mm	28–38 lp/mm	64 lp/mm (typical)
Active vs. Passive	Active infrared illuminator required	Passive but it will work with an infrared illuminator	Passive but it will work with an infrared illuminator	Passive but it will work with an infrared illuminator	Passive but it will work with an infrared illuminator
Tube life		2,000 hours	2,500 hours	2,500 hours	10,000+ hours
Suitable for general tactical observation	No obsolete technology	No obsolete for tactical applications	Acceptable	Acceptable	Best represents the latest technology
Suitable for photography	No	No	Yes but not equal to Gen 2+ or Gen 3	Yes but not equal Gen 3	Yes
Era: First developed and placed into use	Mid 1930s World War II and Korea	1960s Vietnam War	1970s	1970s	1990s Gulf War Enhanced in the 2,000s for improved gain and resolution.

Figure 5-3. High quality third generation (Gen 3) image intensifier night vision devices (NVDs) perform the best for photography although one can do respectable night vision photography using a quality Gen 2+ night vision device. Never use Gen 1 for photography or for direct viewing (refer to the next illustration). *Illumination:* Starlight. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Upper image:* Gen 1. *ISO:* 320. 6-second exposure time. The objective lens was a permanently installed 5x lens. This is a low-cost imported Gen 1 instrument. *Center image:* Gen 2+. ISO 320. 1/10-second exposure time. *Lower image:* Gen 3. ISO 50. 1/10-second exposure time. Gen 3 permits the surveillance specialist to use a lower ISO for enhanced image quality, as done here, or increase ISO somewhat to achieve a faster shutter speed. With only starlight at the time of photographing (no moon), these images have real-life field-application value for illustration purposes. Cyrus Smith (2001, September, p. 47) explains that, "As illumination decreases, the gain in the goggles [any image intensifier NVD] automatically increases, resulting in more goggle-induced noise. The increase in noise results in a decrease in resolution."

Figure 5-4. Never use a Gen 1 image intensifier night vision device (NVD) for direct viewing or for photography. These comparative images leave it clear that available-light conventional photography using high ISO provides higher quality images and a shorter exposure time than is possible with a Gen 1 NVD. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Illumination:* Starlight, no moon. *Upper image:* Night vision image recorded using the DSLR camera with a Gen 1 NVD featuring a permanently installed 5x objective lens. *ISO:* 320. *Shutter speed:* 6-seconds. *Lower image:* Conventional time exposure–no NVD. Image recorded using the DSLR camera with the Canon EF 100mm f/2 USM lens at f/2. *ISO:* 3200. *Shutter speed:* 1.6-seconds. Both images recorded during the same photo-shoot–same time and location. Hence, illumination level was not a variable.

Private investigators (civilians) in some countries cannot legally own Gen 3 NVDs. Nevertheless, they can do quality photography using a Gen 2 NVD. The point is, use the highest quality NVD available. Government personnel such as law enforcement should always use Gen 3.

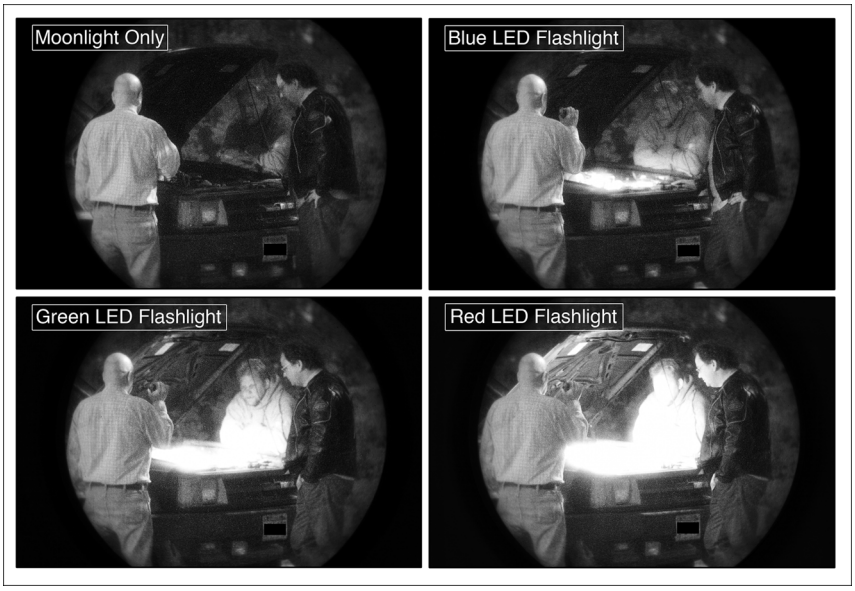

Figure 5-5. These comparative images show how a third generation (Gen 3) image intensifier night vision device responds to different portions (colors) of the electromagnetic spectrum. Gen 3 image intensifier night vision devices (NVDs) are highly responsive to the red region of the visible light spectrum, less responsive to green light, and minimally responsive to blue light. To create these comparative images, the authors used the Streamlight Sidewinder LED Tactical Flashlight (refer ahead to Figure 5-7). *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 200mm f/2.8L II USM telephoto lens. *Night vision device:* Standard AstroScope Night Vision Module. *ISO:* 400. *Shutter speed:* 0.6 second.

SPECTRAL RESPONSE OF NIGHT VISION DEVICES

> At the time of this writing, in the United States, "Lighting of outdoor areas including streets, roadways, parking lots, and pedestrian areas is currently dominated by metal halide (MH) and high-pressure sodium (HPS) sources" (U.S. Department of Energy, 2008, n.p., *LED Application Series: Outdoor Area Lighting*).

The spectral response of third generation (Gen 3) night vision devices (NVDs) is such that they are responsive to light on the red end of the visible light spectrum and responsive to the nonvisible near infrared frequencies. Gen 3 NVDs are highly responsive to red light, less responsive to green light, and minimally responsive to blue light (see Figures 5-5 to 5-8).

The Department of the Army Field Manual 20-3, *Camouflage, Concealment, and Decoys* (1999, August 30, n.p.), reports that on a clear night a red-

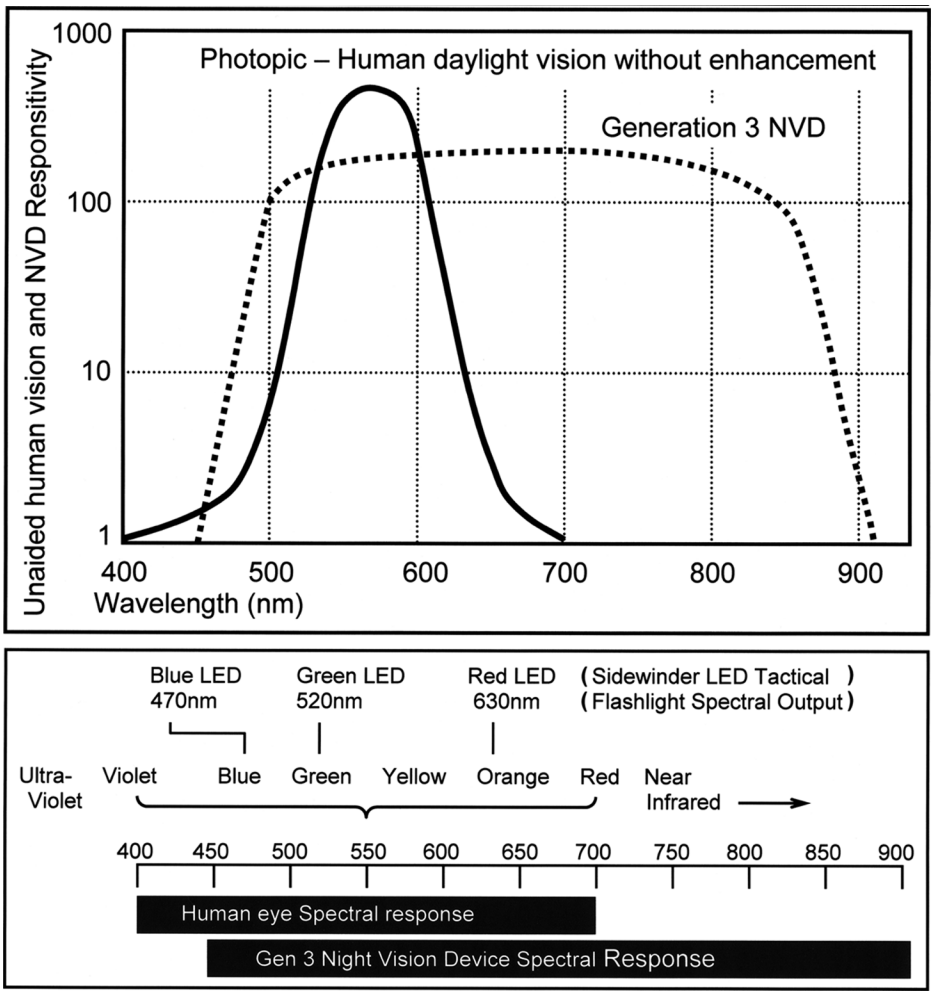

Figure 5-6. During night vision photography, especially in the urban environment, artificial lighting in the subject's vicinity often provides supplemental illumination. The extent that manufactured lighting serves as supplemental illumination depends on the spectral power distribution of the illumination source versus the spectral response of the image intensifier night vision device (NVD) in use. The spectral power distribution of high-intensity discharge (HID) lamps such as High Pressure Sodium (HPS) and Metal Halide (MH) commonly found in streetlights and parking lot lights serve well as sources of supplemental illumination for long-range night vision photography. At the time of this writing, LED technology for outdoor lighting is capturing considerable interest. Spectral power distribution graphs suggest that LEDs will provide supplemental illumination for night vision photography but not to the extent that HPS and MH do. This graph is an approximation–variations exist depending on the quality of intensifier tubes within a generation such as Gen 3, and variations exist depending on who manufactured the image intensifier tube.

Figure 5-7. The Streamlight Sidewinder LED Tactical Flashlight features an LED life of approximately 100,000 hours. The energy distribution of the three LEDs is as follows: Blue, 470 nanometers; green, 520 nanometers; red, 630 nanometers. Some Streamlight Sidewinder LED flashlight models feature an infrared (IR) LED in place of a red LED. This is the flashlight used when recording the images in Figure 5-5.

lens flashlight and a lit cigarette is detectable by use of an image intensifier night vision device from a distance as great as 4.02 kilometers (2.5 miles).

ISO AND IMAGE QUALITY

> As illumination decreases, the gain in the goggles automatically increases, resulting in more goggle-induced noise. The increase in noise results in a decrease in resolution. (Smith, 2001, September, p. 47)

> Scintillation. Also known as electronic noise. A faint, random, sparkling effect throughout the image area. Scintillation is a normal characteristic of microchannel plate image intensifiers and is more pronounced under low-light-level conditions. (Morovision Night Vision, Inc., 2010, n.p., *Scintillation*)

The above epigraphs leave it clear that as illumination increases, intensifier tube gain automatically decreases and that reduces scintillation, which

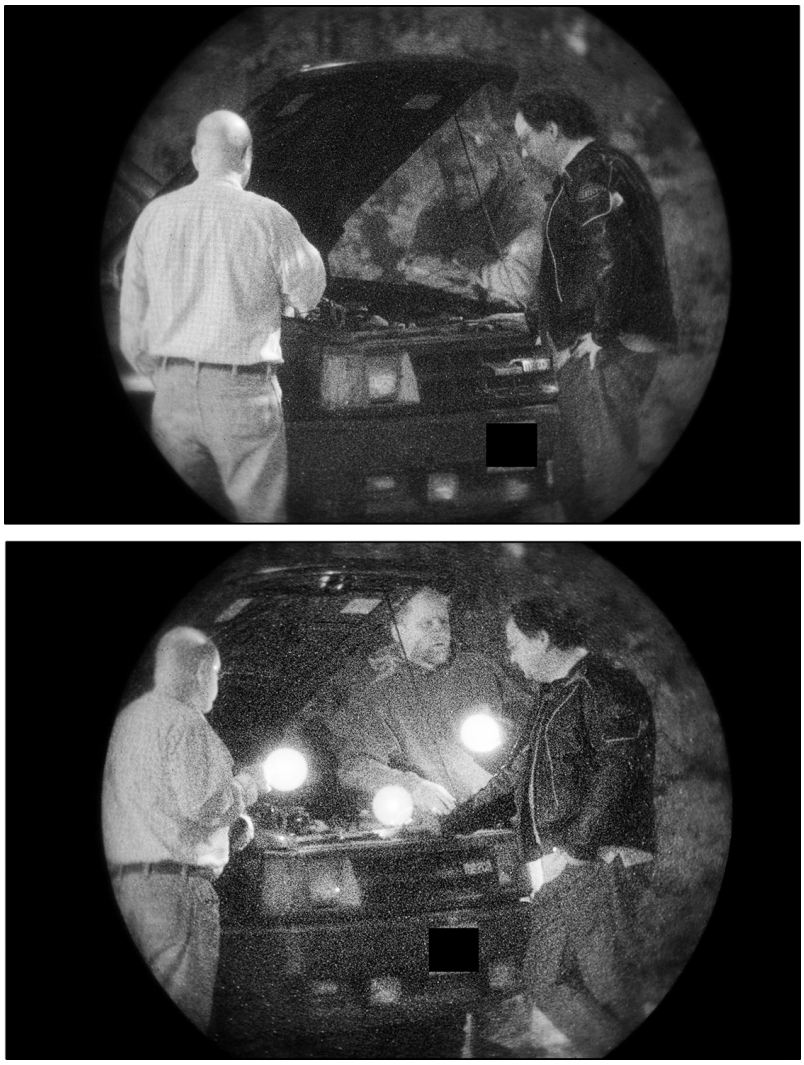

Figure 5-8. Do not smoke in the field. In the lower image, the three individuals each have a cigarette in their hand. Observe the "blooming" around the cigarettes. Information under subheading *Management of Blooming* towards the end of this chapter defines blooming. Image intensifier night vision devices (NVDs) are highly responsive to the radiation emitted by cigarettes. Observe that although the shirt worn by the individual on the left is a dark color, it appears light. The shirt is more reflective in the near infrared region than it is in the visible portion of the electromagnetic spectrum. The shirt is darker in the lower image probably because the intensifier tube adjusted gain in response to the illumination provided by the cigarettes, adjusting gain to maintain constant light output (refer ahead to Figure 5-52). The individual on the left is wearing blue denim jeans. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 200mm f/2.8L II USM telephoto lens. *Night vision device:* Standard AstroScope Night Vision Module. *ISO:* 400. *Shutter speed:* 1/6-second.

improves image quality. Conversely, as illumination decreases, intensifier tube gain automatically increases and that increases scintillation, which degrades image quality.

To achieve the best image quality possible when using an image intensifier night vision device (NVD) for photography, use as low an ISO as ambient lighting permits, preferably ISO 100 or less, and ensure perfect exposure.[5] Additionally, determine what level of NVD manual variable gain provides best results under the circumstances.

When photographing at night using available light without an NVD, increasing ISO usually does not degrade image quality beyond acceptable limits for purposes of pictorial evidence and intelligence. Increasing ISO leaves the surveillance specialist with a usable image because a high quality image can undergo considerable noise induced deterioration before it becomes unusable. That is not true when photographing at night using an image intensifier NVD. Increasing ISO degrades image quality with the ambient level of illumination affecting the extent of image deterioration (see Figure 5-9). Under good nighttime lighting conditions, increasing ISO degrades image quality less than it does under poor nighttime lighting conditions. Increasing the NVD level of manual variable gain tends to degrade image quality more than increasing ISO does.

MANUAL VARIABLE GAIN CONTROL AND IMAGE QUALITY

> I find the manual variable gain feature of an image intensifier night vision device useful during photography because it enables me to achieve the best balance of image brightness, image quality, and shutter speed. (Surveillance specialist–anonymous)

Image intensifier night vision devices (NVDs) feature *fixed gain.* Some also feature *manual variable gain.* Fixed gain NVDs feature Automatic Bright-

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5. Sometimes, during conventional available light photography, the level of nighttime illumination is so low that a shutter speed sufficient to freeze movement of human subjects is not attainable even at maximum ISO. When that occurs, the surveillance specialist increases shutter speed to the minimum necessary to freeze subject movement and shoots to RAW. Later, he or she uses a graphics-editing program featuring an appropriate RAW processor to salvage the underexposed images. When engaged in night vision photography, this method does not work. During night vision photography, never underexpose to obtain a faster shutter speed intending to compensate using a graphics-editing program. During night vision photography, underexposure quickly degrades image quality. A succeeding subheading, *Night Vision Photography and Underexposure,* discusses and illustrates this important issue.

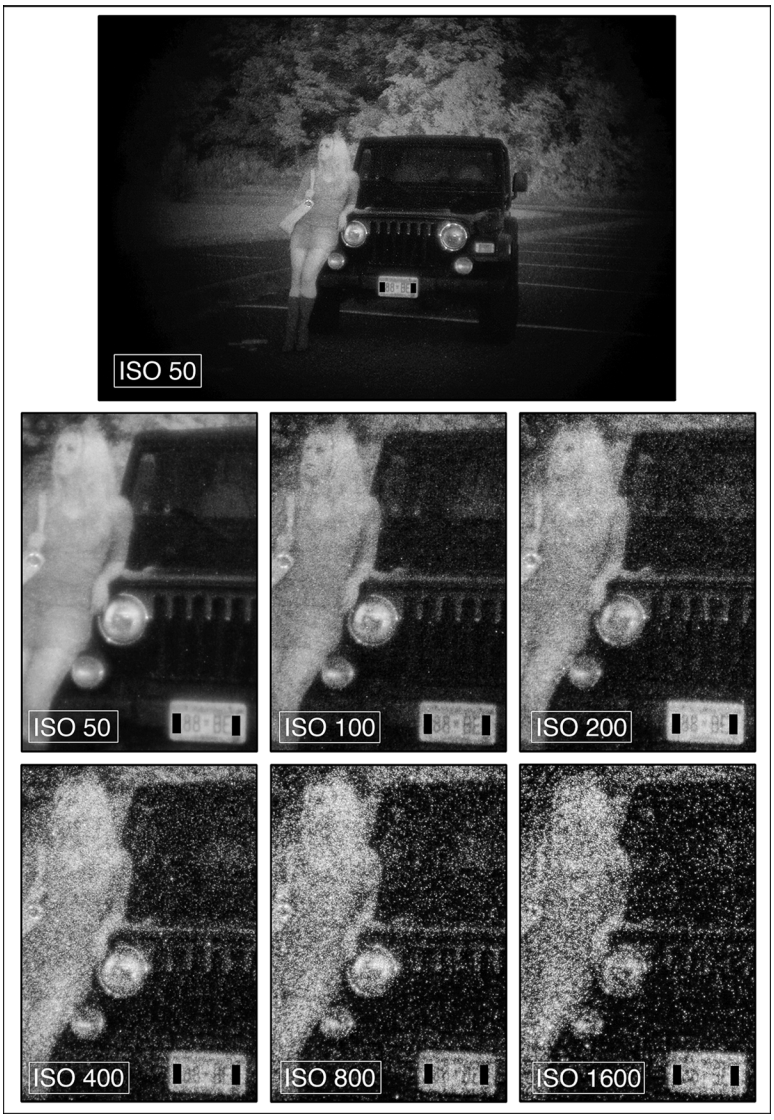

Figure 5-9. When using an image intensifier night vision device (NVD) for photography, increase ISO no more than necessary to obtain a suitably fast shutter speed. Increasing ISO degrades image quality. The top image shows the area of coverage with the lower six images being cropped portions of larger images. The surveillance specialist recorded these images with only starlight illumination–no moonlight or artificial illumination. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 50mm f/1.4 USM lens. *Night vision device:* NEPVS-14 Night Enforcer Gen 3 PINNACLE night vision monocular. Under good nighttime lighting, image quality does not deteriorate as badly when increasing ISO. However, it is during extreme low-light conditions that increasing ISO to achieve a suitably fast shutter speed becomes necessary.

ness Control (automatic intensifier tube gain) that keeps the output image at a certain brightness level. That is, they automatically adjust intensifier tube gain to keep the brightness of the green phosphor screen image reasonably consistent irrespective of the level of ambient illumination. The operator has no control over this function. Manual variable gain NVDs feature Automatic Brightness Control and they permit manual adjustment of output brightness. They enable the operator to manually increase and decrease the brightness of the green phosphor screen image. Manual variable gain permits the user to achieve the optimum balance of brightness, image quality, and shutter speed.

Image quality as affected by the level of camera ISO and manual variable gain is an important issue. As the gain of an NVD intensifier tube increases, scintillation (electronic noise) increases. When photographing with an NVD featuring manual variable gain control, experiment with the relationship between camera ISO and the level of NVD manual variable gain to find the relationship that optimizes image quality while providing a suitably fast shutter speed, under the circumstances.

The illustrations in this section demonstrate the effect that camera ISO and the level of manual variable gain have on image quality relative to clarity and detail. In all instances, the specialist must find the level of camera ISO and NVD manual variable gain that together optimize image quality while providing a suitably fast shutter speed (see Figures 5-10 and 5-11).

The authors asked Morovision Night Vision, Inc. about their experience with these issues, camera ISO versus NVD manual variable gain. They explained that:

> It has been our experience that increasing ISO sensitivity degrades image quality due to the noise levels. However, with variable gain we do not think it degrades image quality so much with increased noise levels as it does with overexposure or too much light. To find the optimal combination setting for each depends on the conditions of the night as well as the distance of your subject matter and the degree of magnification. We think it is best to point out that during night vision photography every "night" is different in terms of conditions and ambient light levels. Additionally, certain camera settings may work well in some situations but not in others. For those reasons, having as many adjustment options as possible in order to adapt to each situation is the best solution. (Morovision Night Vision–Marketing, personal communication, April 8, 2010)

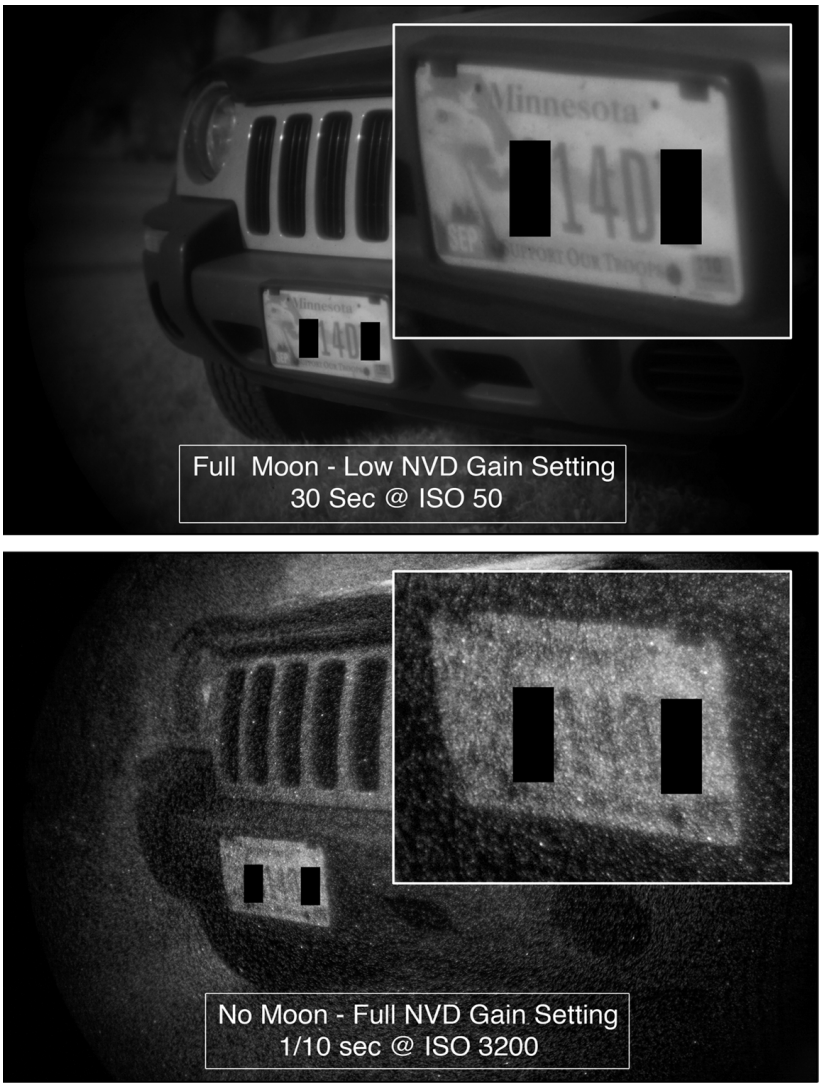

Figure 5-10. These comparative images show the full NVD manual variable gain range result, full moon to no moon using a Canon EOS 5D digital single-lens reflex full-frame camera with the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device. *Upper image:* Full moon (high ambient light level) allowed using the lowest possible ISO and NVD gain settings. *Lower image:* No moon (low ambient light level) required high ISO and high NVD gain. In the lower image, observe the immense amount of noise (scintillation) that results from the higher gain with increased ISO also being a factor. Lack of detail is a factor of noise, but it becomes multiplied by the fact that very little light direction exists in the low ambient light level photo. Remember, light from the moon and stars act just like daylight but with much less intensity. If the light is soft and lacks direction, there is very little highlight and shadow to provide shape.

Figure 5-11. These comparative images show that elevated NVD manual variable gain creates slightly more noise than elevated ISO does. The two images feature essentially the same exposure but achieved by different methods. *Upper image:* Medium NVD gain at higher ISO exhibits less noise. *Lower image:* High NVD gain at lower ISO exhibits more noise. While the difference between the two images may appear negligible, the difference can result in success or failure when attempting to record essential detail such as subject identification (i.e., facial recognition) and legible vehicle number plates from a long distance under poor lighting conditions. Keep in mind that these examples are the result of images recorded under conditions existing at the time of photographing using a certain camera and image intensifier NVD. Each capture system is different and each new generation of digital camera features improved ISO/Noise ratio. Experiment with the equipment in use to determine how it performs under various nighttime field conditions. It was not until completing some of the images for this text that the authors tested and thereafter implemented the lower gain/higher ISO techniques suggested here. *When necessary, use high NVD gain to obtain a brighter image for framing and focusing the subject and then decrease gain for photographing.* When using an image intensifier NVD lacking manual variable gain, use as low an ISO as conditions permit. Continually re-evaluate results and think of new options to try in the quest to achieve the best image quality possible. Night vision photography is fraught with variables!

NIGHT VISION PHOTOGRAPHY AND UNDEREXPOSURE

Chapter 4, under the subheading *Underexposure as a Low-Light Photography Technique,* discusses underexposing as a method to increase shutter speed during conventional low-light photography. Using a graphics-editing program, the surveillance specialist later compensates for the underexposure. While that method is effective for conventional photography, it does not work well with photography using an image intensifier night vision device (see Figure 5-12). The limited resolution of an image intensifier NVD creates a situation where the increased noise present in the underexposed dark areas destroys detail when attempting to lighten the dark areas post capture either with a RAW processor or postprocessing.

When photographing moving objects and people, increasing ISO and the level of manual variable gain is sometimes necessary to achieve a suitably fast shutter speed. When photographing stationary objects and maximum detail is necessary, reduce camera ISO and reduce the level of manual variable gain, and record long duration exposures. Avoid underexposure as a means to reduce exposure time unless that is the only way to achieve a suitably fast shutter speed under the circumstances. In some instances, a low quality photographic image is better than no image.

THE CAMERA'S INTERNAL LIGHT METER

The light meter in some cameras provides correct or nearly correct exposure information when photographing with an image intensifier night vision device. The light meter in other cameras provides incorrect exposure information, which requires making compensatory adjustments. Moreover, various optical configurations such as afocal photography can affect the accuracy of the camera's internal light meter. Achieving correct exposure is important because night vision photography is less forgiving of exposure discrepancies than conventional photography is.

A camera's internal light meter anticipates normal "white" light and therefore it can respond differently to the monochromatic image of a night vision device. Visible light features the full range of colors from violet to red, but the green image provided by a night vision device is largely monochromatic. Green is approximately midway between the violet and red ends of the visible light spectrum. Although the green image does not consist of a single frequency, it does feature a narrow frequency range, which can skew the light meter reading and result in over or under exposure. Moreover, when

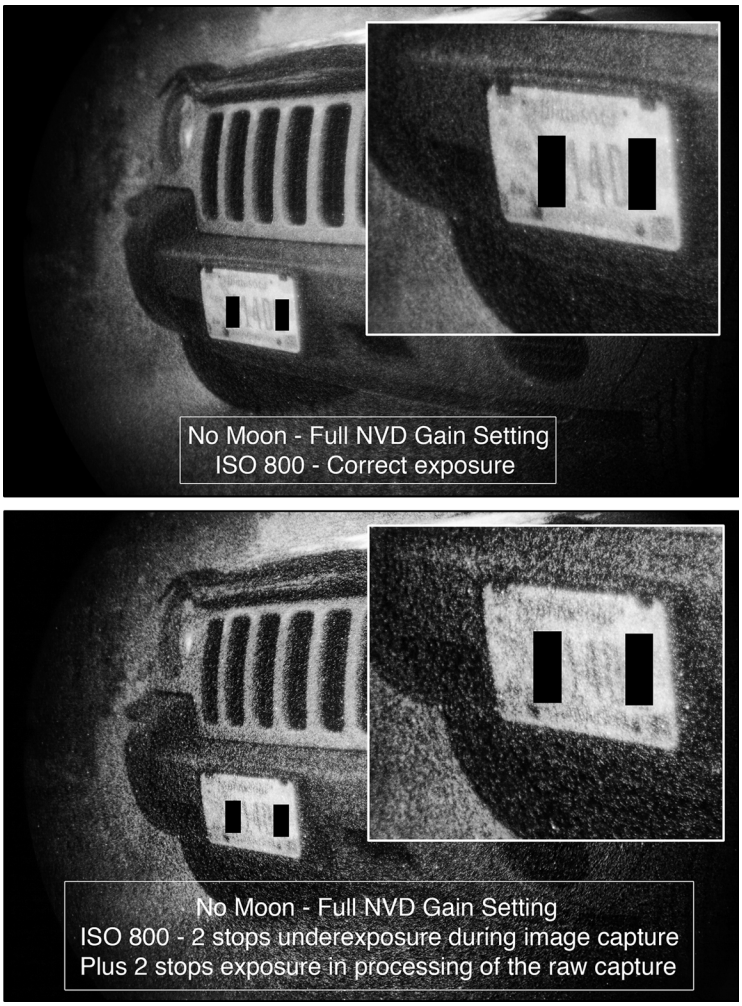

Figure 5-12. These comparative images show the result of underexposing with an image intensifier NVD to increase shutter speed with the intent of lightening the dark areas of the image postcapture. The upper image is properly exposed; 4/10 second, f1.4, ISO 800, and full NVD gain. The lower image was underexposed by two stops allowing the shutter speed to rise to 1/10 second. All other settings remained the same. The raw capture was then processed with Phase One's, Capture One Pro RAW processor with 2 stops of exposure added. During night vision photography, do not underexpose to increase shutter speed.

the image circle does not cover the entire image sensor an inaccurate meter reading can result.

Conduct exposure tests using the cameras, lenses, and night vision devices of choice. For each optical configuration used, compare results of the

various light metering methods such as center-weighted, partial, and spot metering. When incorrect exposure occurs, make the necessary adjustment to achieve proper exposure. Over and underexposure degrades image quality with overexposure also resulting in a slower than necessary shutter speed. Unnecessarily increasing exposure duration is intolerable because shutter speed tends to be slow to begin with during night vision photography.

When using the Canon EOS 5D digital single-lens reflex camera with the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device, one stop more exposure is necessary than the camera internal light meter indicates is needed for proper exposure.

COMPENSATING FOR SLOW SHUTTER SPEED

When using an image intensifier night vision device (NVD) for manual clandestine photography, shutter speed often is slow enough to be a problem. When that is the case, the surveillance specialist can do a number of things to manage the situation, doing them singly or in combination. The methods include:

- Increase ISO to achieve a faster shutter speed. Some digital cameras are more tolerant of increased ISO during night vision photography than others are. Previous discussion addressed this topic with succeeding text treating it further.
- Increase the manual variable gain level of the night vision device (NVD) to increase shutter speed. Increasing manual variable gain tends to degrade image quality more than increasing ISO does. Previous discussion addressed this topic with succeeding text treating it further.
- Increase the f-ratio of the optical system to provide the faceplate of the intensifier tube with a brighter image. When using a Schmidt-Cassegrain telescope with an AstroScope configured for SCT-based photography, an f/6.3 focal-reducer results in an f-ratio gain of 1 1/3 stops. When doing afocal photography, increase f-ratio by using a longer focal length telescope eyepiece. Both methods increase f-ratio, but they reduce magnification. Succeeding text addresses this issue.
- Locate a vantage point closer to the subject and use a shorter focal length faster lens. Succeeding text addresses this issue. There are occasions at night when a surveillance specialist moves in so close to a subject that listening to him or her verbally converse with another person

is possible. The point is, sometimes moving in close to the subject and photographing with a short fast lens is possible.
- Use an infrared (IR) illuminator to increase the level of illumination in the area of the subject, or covertly modify hardwired lighting in the area of the subject. Succeeding text addresses IR illuminators.
- When shutter speed is too slow to freeze movement of human subjects, record numerous sequential images so that some exposures occur during times that the subject pauses. People usually are not in constant motion and for that reason a percentage of usable images will result. Succeeding text addresses this issue.

When photographing several people, recording numerous sequential exposures is especially important because not everybody pauses at the same time. Neither does everybody face the vicinity of the camera at the same time. Recording numerous sequential exposures is necessary to accumulate a percentage of photographs that identify each subject. In addition, the images will document subject activity. In some instances, two or more surveillance specialists must photograph the subjects from multiple directions.

Some situations feature fleeting decisive moments that the surveillance specialist must capture with one well-timed exposure. In such instances, the arbitrary recording of rapid sequential images may not capture the all-important decisive moment. One solution is for two surveillance specialists to photograph the subject area simultaneously. One specialist records numerous sequential exposures using low ISO and low NVD gain and a comparatively slow shutter speed to record high-resolution images. The second specialist sacrifices image quality in favor of using a comparatively high ISO and high level of manual variable NVD gain to achieve a shutter speed fast enough to freeze subject movement. He or she records images selectively to document essential decisive moments. The high ISO high gain images are lower quality, but they document critical events, the so-called decisive moments. In many instances, a low quality image showing a decisive moment is better than no image.

Another possibility is the simultaneous use of a single image camera and camcorder to document subject activity. One surveillance specialist, working alone except for the observer, can simultaneously operate a night vision-adapted camcorder and digital single-lens reflex (DSLR) camera by means of side-by-side mounting (see Figure 5-13). Recording moving video images may require illuminating the subject using an infrared (IR) illuminator. Illuminate the subject from a location remote from the camera.

In the previous illustration (Figure 5-13), supporting the apparatus in both images is the Majestic #1001 3/8″ Screw Mount Gearhead with the 6x7-inch

Figure 5-13. The night vision-adapted camcorder and digital single-lens reflex camera mounted side-by-side move as an integrated unit. This configuration permits the simultaneous recording of moving video images and detailed still images by one surveillance specialist. Alternatively, it permits activating the camcorder for extended duration filming while using a DSLR camera in the high-definition (HD) video capture mode for short duration filming of critical events. *Upper image: Left system:* Canon VIXIA HV30 high-definition camcorder coupled with the ITT NQPVS-14 Gen 3 night vision monocular sporting the Mil-Spec (military specifications) 5x extension magnification lens. *Right system:* Canon EOS 5D digital single-lens reflex (DSLR) full-frame camera, Canon EF 300mm f/2.8L IS USM telephoto lens, and the Gen 3 standard AstroScope Night Vision Module. Replacing the Canon EOS 5D DSLR camera with a DSLR camera featuring high-definition (HD) video capture would permit recording HD moving video images with the benefit of a large image sensor and full manual control. *Lower image: Left system:* The camcorder and night vision device are the same as in the upper image. *Right system:* Afocal coupling using the Canon EOS 5D digital single-lens reflex full-frame camera with a 50mm f/1.4 lens, Canon EF 300mm f/2.8L IS USM telephoto lens with a 50-millimeter telescope eyepiece, and the ITT NEPVS-14 Night Enforcer Gen 3 PINNACLE night vision monocular. Together, the 50-millimeter telescope eyepiece and the 25-millimeter (estimated) objective lens of the night vision device provide an effective focal length and f-ratio of 150mm f/1.4, which is good for extreme low-light night vision photography.

Camera Platform. This head features a load capacity of 15.88 kilograms (35 pounds). If frequent panning is necessary to follow a moving subject, use a heavy-duty fluid head (refer to Figure 4-41 in Chapter 4, lower image).

USING AFOCAL COUPLING TO INCREASE F-RATIO

By means of afocal coupling, the ITT NEPVS-14 image intensifier night vision monocular is highly versatile. It makes ultra-long-range night vision photography possible and it permits creating exceptionally fast optical systems for extreme dark-night photography.

When using an image intensifier night vision device (NVD) for nighttime photography, illumination is sometimes adequate for a suitably fast shutter speed. Conversely, some nighttime conditions are so dark that an insufferably slow shutter speed occurs even when increasing camera ISO and the manual variable gain level of the night vision device. Additionally, exceptionally dark nights result in increased NVD gain, which increases scintillation and reduces image quality. To manage exceptionally low-light conditions during night vision photography, five possible solutions exist. They are:

- Illuminate the subject using an infrared (IR) illuminator. Unfortunately, that takes one from the passive to the active mode and thereby detectable by anybody using an image intensifier night vision device for countersurveillance. Use an IR illuminator as a last resort measure when the likelihood exists that the subject uses a night vision device for countersurveillance. Additionally, never illuminate the subject from the camera location or from anywhere along the line-of-sight between the camera and subject. The exception is during short- to moderate-range photography when illuminating the subject from the camera position is acceptable. Discussion later in this chapter addresses infrared (IR) illuminators.
- Using an f/6.3 focal-reducer with a Schmidt-Cassegrain telescope (SCT) provides an effective f-ratio gain of 1 1/3 stops. The focal-reducer makes an f/10 SCT an f/6.3 telescope, and it makes an f/11 SCT an f/7 telescope. While a focal-reducer increases the f-ratio by 37 percent, it reduces magnification by the same amount.
- An f/6.3 focal-reducer and 1.4x tele-converter used together with a Schmidt-Cassegrain telescope (SCT) results in a magnification reduction of approximately thirteen-percent and an f-ratio gain of 1/3 stop. For example, the f/6.3 focal-reducer and 1/4x tele-converter used

together with the 2350mm f/10 Celestron C9.25″ SCT results in an effective focal length and f-ratio of 2073mm f/8.82.

- Use afocal coupling to increase the f-ratio of the optical system. When the focal length of the telescope eyepiece exceeds the focal length of the lens looking through the eyepiece (e.g., the 25mm objective lens of an NVD) magnification decreases and f-ratio increases (refer back to Figure 5-13, lower image).
- Use a focal-reducer and long focal-length telescope eyepiece together on a Schmidt-Cassegrain telescope (SCT). Stated above, when the focal length of the telescope eyepiece is greater than the focal length of the lens looking through the eyepiece, f-ratio is increased. Example: Using the f/6.3 focal-reducer and 56mm telescope eyepiece with the 3048mm f/10 12″ Meade LX90-SC telescope and NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device results in an effective focal length and f-ratio of 853mm f/2.8.

By means of afocal coupling, the surveillance specialist can increase magnification or increase f-ratio. Increasing one reduces the other. Using afocal coupling to increase magnification simultaneously reduces the effective f-ratio of the optical system; the system becomes slower. Using afocal coupling to decrease magnification simultaneously increases the effective f-ratio of the optical system; the system becomes faster.

When using afocal coupling to increase the f-ratio of the optical system, the specialist uses a telescope eyepiece featuring a focal length greater than the focal length of the lens looking into the eyepiece, previously stated. When using an SCT, if in need of an f-ratio greater than afocal coupling makes possible, the specialist places an f/6.3 focal-reducer on the telescope and then mounts a telescope eyepiece to the focal-reducer.

Using afocal coupling to increase effective f-ratio provides the faceplate of the intensifier tube with a brighter image. The result is less automatic intensifier tube gain and therefore better image quality, and it permits using a faster shutter speed (see Figure 5-14). Reduced intensifier tube gain results in less scintillation and that improves image quality. Although a brighter image on the faceplate of the intensifier tube permits using a faster shutter speed, shutter speed does not increase to an extent that corresponds to the increased brightness of the image. The reason for this becomes clear shortly.

When doing afocal photography or videography without a night vision device, a telescope eyepiece featuring greater focal length than the camera or camcorder lens reduces magnification and increases the f-ratio. The optical system becomes faster and therefore the image projected onto the cam-

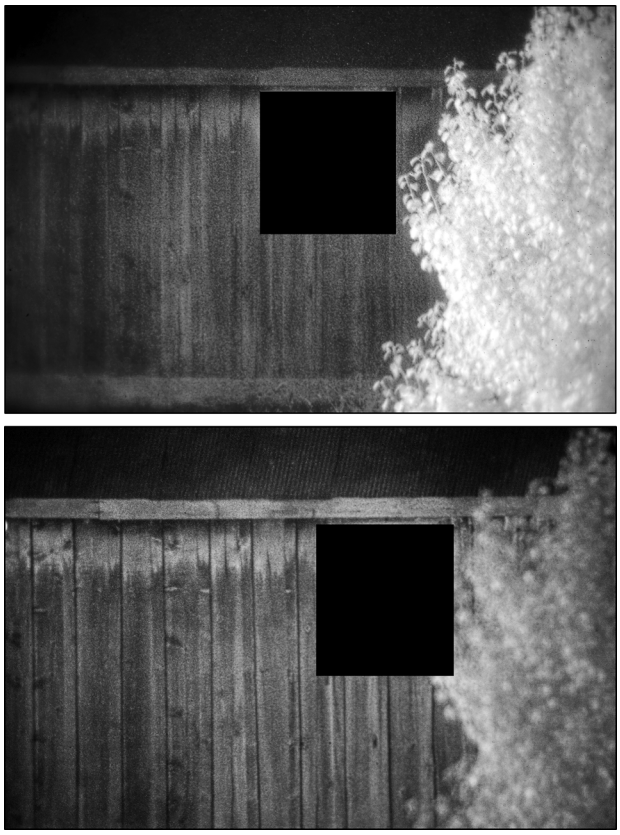

Figure 5-14. The afocal method of photography provides the means to increase the effective f-ratio (speed) of an optical system for extreme low-light image intensifier night vision photography. On a very dark night from a distance of 342.9 meters (375 yards), the surveillance specialist photographed this barn using two different systems for night vision photography. *Upper image:* Image recorded using the Special-Order Battery-Adapted AstroScope. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensorcamera. *Telescope:* 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope (SCT) and f/6.3 focal-reducer. *Effective focal length and f-ratio:* 945mm f/6.3. *ISO:* 100. *Shutter speed:* 3 seconds. *Lower image:* Image recorded using afocal coupling. *Night vision device:* NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera with a 50mm f/1.4 lens. *Telescope/ Optical System:* 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope, f/6.3 focal-reducer, and 50mm telescope eyepiece. *Effective focal length and f-ratio:* 740mm f/3.15 (two stops increase over f/6.3). *ISO:* 200. *Shutter speed:* 2 seconds. These comparative images illustrate the effectiveness of using afocal coupling to increase f-ratio and thereby improve image quality during exceptionally dark-night photography although in this instance moving human subjects would require using an infrared (IR) illuminator. It was a very dark night! Explained shortly, increasing f-ratio increases the brightness of the image reaching the faceplate of the intensifier tube, which reduces automatic gain and thereby increases image quality. Nevertheless, also stated, shutter speed does not increase to an extent that corresponds to the increased brightness of the image reaching the faceplate of the intensifier tube. Shutter speed increases a little but image quality increases a lot.

era image sensor is brighter. The brighter image permits using a faster shutter speed or a lower ISO, or both. The increased shutter speed is proportional to the increased brightness of the image. The situation is different when doing afocal photography or videography using an image intensifier night vision device.

When using afocal coupling to increase the f-ratio of a telephoto lens or telescope during night vision photography, the image projected onto the faceplate of the intensifier tube is brighter. The result is reduced automatic intensifier tube gain and thus better image detail but not a significant shutter speed increase. A shutter speed increase proportional to the increased brightness of the image reaching the faceplate of the intensifier tube does not occur because the Automatic Brightness Control (automatic intensifier tube gain) feature of the intensifier tube keeps the brightness of the green phosphor screen image reasonably consistent. As the brightness of the image reaching the faceplate of the intensifier tube increases and decreases, tube gain increases and decreases, but the brightness of the phosphor screen image remains reasonably constant. To be sure, increasing f-ratio does result in a faster shutter speed, but not to an extent one would expect, not to an extent equal to the increased brightness of the image reaching the faceplate of the intensifier tube.

The following examples pertain to afocal night vision photography using the ITT NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device or comparable NVD monocular. The examples pertain to using afocal coupling to increase effective f-ratio. The following values assume that the objective lens of the night vision device is 25 millimeters, the exact focal length not disclosed by the manufacturer because that information is ITAR controlled. Later discussion addresses ITAR controls.

- 50-millimeter telescope eyepiece on the 3048mm f/10 12″ Meade LX90-SC telescope. Effective focal length and f-ratio 1524mm f/5.
- 50-millimeter telescope eyepiece and f/6.3 focal-reducer on the 3048mm f/10 12″ Meade LX90-SC telescope. Effective focal length and f-ratio 960mm f/3.15.
- 56-millimeter telescope eyepiece on the 4064mm f/10 16″ Meade LX200-ACF telescope. Effective focal length and f-ratio 1814mm f/4.46.
- 56-millimeter telescope eyepiece and f/6.3 focal-reducer on the 4064mm f/10 16″ Meade LX200-ACF telescope. Effective focal length and f-ratio 1143mm f/2.8. At this time, it is unknown how well an f/6.3 focal-reducer works with flat field telescopes because the authors have not yet experimented with them. Refer to Chapter 2 subheading *F/6.3 Focal-Reducer and Flat Field Catadioptric Lenses.*

Chapter 4, under the subheading *Afocal Coupling to Increase F-Ratio,* discusses the use of afocal coupling to increase f-ratio for low-light long-range photography without a night vision device.

The problem with using a refracting telescope for afocal photography with or without a night vision device is the fact that the eyepiece moves in and out during focusing. Refracting telescopes feature either a rack and pinion or Crayford-style focusing mechanism that focuses the eyepiece by moving it closer and farther from the objective lens.[6] The in/out travel of the eyepiece is a problem unless devising a system that permits the camera to move with the eyepiece. Afocal photography using a Canon or Nikon telephoto lens or a Schmidt-Cassegrain telescope is uncomplicated from the standpoint that the telescope eyepiece remains stationary during focusing.

MOONLIGHT

> Think of moonlight as low-intensity sunlight. Indeed, moonlight is sunlight reflected from a localized surface–the moon.

When preparing for a night vision photography mission, one must consider the level of anticipated nighttime illumination and plan accordingly. Some degree of illumination is necessary because image intensifier night vision devices (NVDs) do not work in total darkness; they amplify existing light. Common sources of nighttime illumination include sky glow, moonlight, starlight, and nearby or distant manmade lights. Frequently, more than one source simultaneously provides nighttime illumination, especially in urban and semiurban environments.

In the rural environment, the moon and stars are often the only illumination sources for night vision photography. Logic correctly suggests that a full moon provides more light than a three-quarter, half, or one-quarter moon does. It is important to understand, however, that a half moon provides less than half the illumination of a full moon. Similarly, a one-quarter moon provides less than a fourth the illumination of a full moon. Actually, the difference is considerable as the following examples illustrate:

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6. A telescope rack and pinion focuser features a pair of gears that convert rotational motion into linear motion. Unfortunately, this type of focuser features some degree of slop (backlash) in the gear teeth that makes precision focusing difficult in some instances. Naturally high quality rack and pinion focusers feature greater precision and therefore better performance than inexpensive focusers. Crayford-style focusers are friction driven and therefore feature no backlash to interfere with precision focusing. Unfortunately, because they are friction driven, they sometimes struggle with the weight of a camera. Naturally, high quality Crayford-style focusers perform better than low-cost models.

- Full moon: 100 percent illumination.
- Three-quarter moon: 40 percent illumination.
- Half moon: 15 percent illumination.
- One-quarter moon: 8 percent illumination.

The above percentages are approximations because of variables such as phase angle, atmospheric conditions, and the varied reflectivity of different potions of the lunar surface, the latter called albedo (Andy Munro, personal communication, March 27, 2010).

With a clear sky and full or nearly full moon, an image intensifier night vision device performs well and a sufficiently fast shutter speed often is possible, especially if using a short fast lens. If, however, photographing occurs under a half moon or less or when the night sky is overcast, shutter speed can be insufferably slow. High magnification always requires mounting the apparatus to a tripod or some other suitable support. Low magnification large aperture (short and fast) lenses usually permit handholding the camera assembly, but a gyrostabilizer is sometimes necessary (see Figure 5-15).

Think of moonlight as low-intensity sunlight in terms of how it behaves, such as direction of illumination, what it illuminates, highlight and shadow areas, the shadows it casts, and the silhouettes it creates (see Figure 5-16 and refer to Figure 6-14 in Chapter 6). For additional information on this topic, refer to Chapter 6, subheading *Near Infrared (NIR) Compliant Clothing.*

RAIN, SLEET, SNOW, AND FOG DURING NIGHT VISION PHOTOGRAPHY

> Night vision is very responsive to reflective ambient light; therefore, the light reflecting off fog or heavy rain causes much more light to go toward the night vision unit and may degrade its performance. (Morovision Night Vision, 2008, n.p., *How Night Vision Works*)

When using an image intensifier night vision device for photography while rain, sleet, or snow is falling, or when fog is present, expect diminished image quality. Image quality suffers because precipitation and fog scatters light. Moreover, using an infrared (IR) illuminator during precipitation or fog illuminates the moisture in the air and the moisture scatters the infrared radiation, which obscures the target. The result is the same as driving in fog with the headlights of the vehicle on high beam.

When snow covers the ground during night vision photography, a somewhat faster shutter speed often is possible because of the reflective quality of

Figure 5-15. The Kenyon KS-8 gyrostabilizer supports the Monocam night vision camera system. The NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device sports the Mil-Spec (military specifications) f/2.4 5x extension magnification lens. Battery pack and inverter not shown.

snow. Realize, however, that snow cover will usually improve image quality more than it will increase shutter speed. That occurs because the Automatic Brightness Control (automatic intensifier tube gain) feature of the night vision device automatically adjusts intensifier tube gain to keep light output constant (i.e., keeps the brightness of the green phosphor screen image within defined limits). Earlier discussion addressed this issue under the subheading *Using Afocal Coupling to Increase F-Ratio.*

Snow on the ground reflects light whether it is sunlight during the day or moonlight, starlight, sky glow, or manufactured light at night. The reflective quality of snow tends to create even illumination and minimize shadow areas. When using a night vision device to view and/or photograph into a

Figure 5-16. This night vision photograph recorded from 161 meters (176 yards) illustrates that moonlight behaves much like sunlight. The moon illuminates these subjects from the left and therefore it illuminates the face and front of the garments of the subject on the right while the face and front of the garments of the subject on the left is shadowed and lacking detail. Observe the ground shadows. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 600mm f/4L IS USM telephoto lens. *Night vision device:* Standard AstroScope Night Vision Module. *ISO:* 100. *Aperture:* f/4. *Shutter speed:* 0.8 second. *Atmosphere:* Clear except for ground fog encroaching. *Illumination:* 97 percent moon, and stars.

wooded area beyond a snow-covered open area, a quality view into the wooded area usually does not occur. A poor view into the wooded area results because in response to the better-illuminated snow-covered open area the NVD automatically gains down which leaves the wooded area obscured by comparative darkness.

EXTREME MAGNIFICATION REQUIRES A NIGHT VISION FINDER SCOPE

Astronomers mount a crosshair finder scope to their telescope to ease the task of locating a distant heavenly body. A finder scope is a low-magnification telescope that moves with the high-magnification telescope. Most finder scopes feature 6x, 8x, or 9x magnification. Extreme-distance night vision photography requires using an image intensifier finder scope. A 6x magnification night vision weapon sight featuring a reticle serves well for this purpose.

Figure 5-17. The MV-760-3P Generation 3 Pinnacle Weapon Sight mounted parallel with the telescope serves as a finder scope, the two moving as an integrated unit. This weapon sight, marketed by Morovision Night Vision, Inc., features a reticle, 6x magnification, and 8-degree angle-of-view. Without a weapon sight serving as a finder scope, locating a distant subject in the dark of night is difficult and time consuming (refer ahead to Figures 5-26, 5-39, and 5-40). Between the telescope and DSLR camera is the Special-Order Battery-Adapted AstroScope. The Celestron mini-geared head supporting the weapon sight permits precise alignment of the two optical systems. The Majestic geared head supports the *Dual Scope Mounting Dovetail* featuring two saddles, one on each end. Each saddle accepts a dovetail mounting plate, one on the telescope and the other on the weapon sight. ScopeStuff sells the Dual Scope Mounting Dovetail and dovetail mounting plates (www.scopestuff.com). The authors purchase 13-inch long dovetail mounting plates, cut sections to the required length, and then drill holes where required, tapping female threads when necessary. *Note:* This is the optical system used to record the night vision image appearing in Figure 5-26, although the surveillance specialist recorded that image using a 1.4x tele-converter and crop-sensor DSLR camera. The Canon EOS-1D Mark IV digital single-lens reflex camera illustrated here permits recording high-definition (HD) video. The APS-H size sensor of this professional grade DSLR camera features a focal length conversion factor of 1.3x relative to angle-of-view.

From this point forward, much of the information in this chapter addresses extreme-distance night vision photography. Extreme distance requires high magnification, which makes photographing with a Schmidt-Cassegrain telescope (SCT) or one of the flat field telescopes necessary. Because high-magnification SCTs provide a narrow angle-of-view, often less than one degree, quickly locating a distant subject requires using an image intensifier finder scope. Nobody manufactures such a finder scope, but fortunately a 6x

magnification night vision weapon sight featuring a reticle serves well for this purpose (see Figure 5-17).

Lacking a night vision weapon sight, an alternative is to mount an image intensifier night vision monocular with a 5x extension magnification lens to the telescope to serve as a finder scope. Center something in the view provided by the telescope and then adjust the night vision monocular to center the same subject. Although a night vision monocular lacks a reticle, it will aid in locating the area of a subject and positioning the SCT so that only minimal framing correction thereafter is necessary.

Night vision weapon sights commonly feature a shuttered eye guard to prevent the emission of light when the observer's face is not applying pressure to it. That can present a problem when using the weapon sight as a finder scope because pressure applied to the eye guard can interfere with articulation of the telescope. For that reason, a nonshuttered eye guard is more convenient to use.

For photographic applications, use a shuttered eye guard only when extreme covert requirements make it necessary. Keep in mind that when magnification is so great that using a weapon sight as a finder scope is necessary, camera-to-subject distance is great enough to minimize the need for a shuttered eye guard. However, a shuttered eye guard is necessary when a subject uses an image intensifier night vision device for countersurveillance. Activate the weapon sight only when needed to position the telescope to cover the subject area and then turn it off.

During extreme-distance night vision photography, a weapon sight works well to locate a distant subject area, but usually detail is not adequate to closely observe the subject and select decisive-moment exposures. That is because photographing typically occurs from beyond the effective range of the weapon sight. For example, the weapon sight in the previous illustration features 6x magnification, while the telescope provides 47x magnification. During extreme-distance night vision photography, the surveillance specialist sometimes uses magnification exceeding 100x (refer ahead to Figure 5-39, magnification in that instance being seventeen times that of this 6x weapon sight).

During extreme-distance night vision photography, when observing the subject to record decisive-moment exposures is necessary, use a second telescope fitted with an image intensifier night vision device for direct viewing. Accomplish this using a monocular night vision device or an AstroScope configured for direct viewing.

NIGHT VISION PHOTOGRAPHY SYSTEMS

Of the various systems for night vision photography, the AstroScope is the most user-friendly and it features superior performance. Sofradir EC, Inc. optimized the AstroScope for photography while the design of monocular night vision devices anticipates direct viewing, not photography.

Recording suitable detail during night vision photography requires that the size of the image relative to the size of the camera frame be larger than is necessary during daytime photography. That is because the image sensor in modern digital cameras and camcorders records greater resolution than a third generation (Gen 3) image intensifier night vision device delivers. The resolution of a Gen 3 night vision device approximates the resolution of a 3 megapixel digital camera. Frank Vallese, Sc.D., President, Sofradir EC, Inc., manufacturer of the Electrophysics AstroScope™ Night Vision Module system explains this as follows:

> Based on the current state-of-the-art in spatial resolution for image intensifier tubes, the use of a digital camera having greater than or equal to 3M pixels will be sufficient to capture the best resolution that the intensifier can deliver. The use of higher resolution digital cameras may be convenient (because of their increased availability) but will not significantly enhance the overall system resolution. (Frank Vallese, personal communication, February 3, 2011)

Usually, if the height of a human subject fills one-fifth to one-forth the height of a digital single-lens reflex camera frame, the image will provide subject identification (i.e., facial recognition). Naturally, many variables affect this such as image resolution as determined by the f-ratio of the optical system and the level of ambient illumination, both of which determine the intensity of the light reaching the faceplate of the intensifier tube and thus the extent of intensifier tube gain. Increased tube gain results in increased scintillation, which diminishes image detail.

Night vision photography is possible using a digital single-lens reflex camera, digital pocket camera, or a camcorder. Although designed for direct viewing, most handheld monocular image intensifier night vision devices (NVDs), also called pocket scopes, are camera adaptable and in that capacity they perform well. Sofradir EC, Inc. designed the AstroScope Night Vision Module system specifically for photography and in that capacity, it excels.

Of the various systems for night vision photography, the AstroScope is the most user-friendly and it features superior performance. Sofradir EC, Inc.

optimized the AstroScope for photography while the design of monocular night vision devices anticipates direct viewing, not photography.

ELECTROPHYSICS ASTROSCOPE NIGHT VISION MODULE

When using an AstroScope with a high-magnification Schmidt-Cassegrain telescope for extreme-distance night vision photography, it is not necessary that the camera system be in darkness. The only visible light and near infrared frequencies reaching the faceplate of the intensifier tube of the night vision device is that from the distant dark subject area. Light enters a telescope only from within the confines of the lens's narrow angle-of-view and therefore the night vision device is unaffected by the elevated illumination around it. Keep this in mind during vantage point selection. Naturally, subdued illumination is preferred and using a lens shade or ARD is important to prevent extraneous light entering the telescope from outside its field-of-view.

Introduction

The family of AstroScope models manufactured by Sofradir EC, Inc. consists of various standard AstroScope models, the Special-Order Battery-Adapted AstroScope, and the highly sophisticated and versatile SCT-Configured AstroScope. The Special-Order Battery-Adapted AstroScope and the SCT-Configured AstroScope is each a night vision photography breakthrough. Both permit using a digital single-lens reflex (DSLR) camera with a high-magnification Schmidt-Cassegrain telescope (SCT) to record still images and HD video from distances in the range of 0.80–1.61 kilometers (0.5–1 mile). That is, for recording recognizable images of human subjects and legible vehicle number plates.

Standard AstroScope models work with DSLR cameras, select camcorders, and broadcast video equipment and the dedicated electro-optical lenses for each camera/camcorder system. The Special-Order Battery-Adapted AstroScope works with nonelectronic lenses such as refracting telescopes and Schmidt-Cassegrain telescopes. The versatile SCT-Configured AstroScope works with electro-optical Canon and Nikon lenses and it works with nonelectronic lenses such as refracting telescopes and high-magnification Schmidt-Cassegrain telescopes (SCTs).

SPECIAL-ORDER BATTERY-ADAPTED ASTROSCOPE. The Special-Order Battery-Adapted AstroScope works with nonelectronic lenses such as high-magnification SCTs. The camera works with nonelectronic lenses because this AstroScope model leaves the camera blind to the existence of the

AstroScope. Being unaware of the AstroScope and telescope the camera does not attempt to communicate with a dedicated electro-optical lens. *Important point:* This AstroScope model works with dedicated electro-optical Canon and Nikon lenses, but the lenses do not function as automatic lenses. Because no electronic connection exists between the camera and lens, the lens is inactive at maximum aperture as if it were a fixed aperture manual focus nonstabilized lens. The lens's image stabilization, aperture control, and autofocus features are inactive. This AstroScope model requires an external battery pack (refer ahead to Figure 5-23).

SCT-CONFIGURED ASTROSCOPE. The SCT-Configured AstroScope consists of a special Front Lens Adapter (FLA) that permits photographing with both dedicated electro-optical Canon and Nikon telephoto lenses and with nonelectronic lenses such as refracting telescopes and Schmidt-Cassegrain telescopes. When used with Canon and Nikon cameras and lenses, electronics in the special Front Lens Adapter (FLA) permit communication between the camera and lens. Therefore, the camera and lens function together in the manner intended by Canon and Nikon. The camera electronically communicates with the lens without being aware that an AstroScope physically separates them. When using this AstroScope with nonelectronic lenses (i.e., telescopes), electronics in the special Front Lens Adapter (FLA) causes the camera to "believe" it is communicating with an electro-optical lens. Therefore, the camera functions normally. This AstroScope, like the standard AstroScope models, is parasitic, meaning it receives electrical power from the camera battery.

Previously stated, the SCT-Configured AstroScope and the Special-Order Battery-Adapted AstroScope are a revolutionary night-vision photography breakthrough. They permit DSLR camera-based single image photography and HD videography from unprecedented distances, distances previously possible only during daylight hours, distances of 0.80–1.61 kilometers (0.5–1 mile).

Standard AstroScope Night Vision Module

When using the standard AstroScope with a digital single-lens reflex camera electronic communication between the camera and lens continues. That permits the camera to control lens aperture and image stabilization remains active. Auto-focus remains operable, but manual focus is required during night vision photography.

Figure 5-18. Positioned between the Canon 600mm f/4 telephoto lens and the Canon digital single-lens reflex camera, the standard AstroScope Night Vision Module makes this an efficient night vision camera system for intermediate distances. Covering the lens is the LensCoat™ lens cover featuring the Forest Green pattern.

Introduction

Located between the camera or camcorder and lens, the standard AstroScope Night Vision Module features electrical contacts and an electrical harness that permits seamless electronic communication between the camera and lens (see Figures 5-18 and 5-19, and refer ahead to Figure 5-28). Seamless integration permits operating the camera in the usual manner. It also enables the camera to add information to the image file, information such as camera and lens used, aperture, shutter speed, time, and date. The standard AstroScope is parasitic meaning that it receives electrical power from the camera battery.

Since the authors acquired the standard AstroScope model featured here, the manufacturer added manual variable gain control as a desirable optional feature. Manual variable gain permits increasing and decreasing image tube brightness according to the level of ambient illumination. Manual variable gain permits finding the camera ISO and NVD manual variable gain

Figure 5-19. The standard AstroScope Night Vision Module, positioned between the camera and lens, features an electrical system permitting electronic communication between the camera and lens. That permits operating the camera in the usual manner. Featured here with the AstroScope is the Canon EF 300mm f/2.8L IS USM telephoto lens and Canon digital single-lens reflex crop-sensor camera.

levels that together optimize image quality while providing a suitably fast shutter speed.

Pros and Cons

- ***Pros:***
  - Optimized for photography, the AstroScope provides the best image quality of the various night vision photography systems presented in this chapter. In fact, AstroScope image quality is the standard against which the authors compare the image quality provided by other night vision systems and the various hybrid configurations presented in this chapter.
  - User friendly and versatile—general photography skill required for short- to intermediate-range photography. Telephoto photography experience is necessary for long-range applications using the SCT-Configured AstroScope and the Special-Order Battery-Adapted AstroScope. The design of the standard AstroScope and the SCT-Configured AstroScope permits electronic communication between the camera and dedicated electro-optical lenses. Therefore, the camera continues to control functions such as lens aperture, autofocus, and image stabilization (vibration reduction).

- The standard AstroScope does not work with nonelectronic lenses such as refracting telescopes and Catadioptric telescopes. Photographing with telescopes requires using either the SCT-Configured AstroScope or the Special-Order Battery-Adapted AstroScope.
- The SCT-Configured AstroScope works with dedicated electro-optical lenses in the same manner that the standard AstroScope does. Additionally, it works with nonelectronic lenses such as telescopes.
- The Special-Order Battery-Adapted AstroScope works with nonelectronic lenses (e.g., telescopes), as stated. It also works with dedicated electro-optical Canon and Nikon lenses, but because no communication between the camera and lens occurs, the lens is inactive at maximum aperture. Auto-focus, aperture control, and image stabilization (vibration reduction) are not active. Manual focusing is required although that is preferred during night vision photography.
- When using the standard AstroScope and SCT-Configured AstroScope with dedicated electro-optical Canon and Nikon lenses, the electronic connections of the AstroScope permits the image file to record information such as the camera and lens used, aperture, shutter speed, time, and date.
- The standard AstroScope and the SCT-Configured AstroScope are suitable for short- to intermediate-range photography and videography of fast moving situations. This is possible because the AstroScope mounted seamlessly between the camera body and lens permits the camera and lens to function in the usual manner. The SCT-Configured AstroScope, as stated, also permits ultra-long-range photography using high-magnification Schmidt-Cassegrain telescopes.
- The AstroScope's *Central Intensifier Unit (CIU)* is compatible with the *Front Lens Adapter (FLA)* and *Back Body Adapter (BBA)* for a variety of cameras and camcorders. That makes purchasing only one CIU necessary even though using the AstroScope with different models of cameras and camcorders.
- The AstroScope system is versatile inasmuch as one can mix some Front Lens Adapters (FLA) with some Back Body Adapters (BBA) for creative configurations. For example, the surveillance specialist can use the FLA for Canon or Nikon telephoto lenses with a BBA made for a camcorder (refer ahead to Figure 5-27, lower image).
- AstroScope models are available with and without manual variable gain control. Manual variable gain control provides advantages that are worth the added cost.

  - The AstroScope is more rigid and less prone to vibration than a camera and image intensifier night vision monocular configured for afocal photography using a high-magnification Schmidt-Cassegrain telescope.
  - The AstroScope is adaptable to the BushHawk® Shoulder Mount, the Roc Stoc™ Tactical Shoulder Stock Rail Interface system manufactured by Morovision Night Vision, Inc., and it is adaptable to Kenyon gyrostabilizers.
- ***Cons:***
  - Availability. The AstroScope is not available to surveillance specialists in all countries.
  - Price/cost. The AstroScope costs more than a quality image intensifier night vision monocular, although the price represents excellent value when considering user-friendliness and superior photographic performance.
- ***Best Uses:*** The standard AstroScope excels at short- to intermediate-range night vision photography and videography. It is suitable for fast moving situations requiring impromptu photographing and panning to follow a moving subject. For handheld use, consider mounting the AstroScope to a Kenyon KS-6 or KS-8 gyrostabilizer. Apparatus weight determines which gyrostabilizer model to use. Gyrostabilizers are expensive but worth the cost. The SCT-Configured AstroScope and the Special-Order Battery-Adapted AstroScope, designed for use with nonelectronic lenses such as refracting telescopes and high-magnification Schmidt-Cassegrain telescopes make extreme-distance night vision photography and DSLR camera HD videography possible. Being user-friendly, these two models make extreme distance night vision photography and large image sensor HD videography possible with a lower level of technical expertise than hybrid methods require.

Three-Part Modular Assembly

The AstroScope Night Vision Module is a three-part modular assembly. The *Central Intensifier Unit (CIU)* creates the enhanced image, the *Back Body Adapter (BBA)* accepts the camera, and the *Front Lens Adapter (FLA)* accepts the lens (see Figure 5-20). The design of the AstroScope system permits the surveillance specialist to purchase one CIU and then use it with the adapters for the camera and lens he needs at the time. In the event that advancing technology results in a new and improved CIU, purchasing only the upgraded CIU is necessary. As new camera models appear on the market, new adapters to accommodate them will become available, adapters compatible with the existing CIU.

Figure 5-20. The AstroScope Night Vision Module is a three-part modular assembly consisting of the *Central Intensifier Unit (CIU)* that creates the enhanced image, *Back Body Adapter (BBA)* that accepts the camera, and *Front Lens Adapter (FLA)* that accepts the lens. Once assembled the AstroScope is a compact and integrated unit measuring 12.2 centimeters (4.8 inches) in length and weighing only 0.608 kilograms (1.34 pounds). The lower image shows the assembled Special-Order Battery-Adapted AstroScope with the Canon EOS Rebel T3i digital single-lens reflex crop-sensor camera and the Canon EF 300mm f/2.8L IS USM telephoto lens on the Morovision Roc Stoc Tactical Shoulder Stock Rail Interface system. This Canon crop-sensor DSLR camera, like the Nikon D5100 DSLR camera, features full high-definition (HD) movie mode with manual exposure control and a vari-angle 76.2 millimeters (3.0 inch) LCD monitor. The specialist can mount the telescoping bipod legs to the Roc Stoc so that they fold backward or forward for transport and storage, mounted to fold forward in this image. Resting the forward folded but extended bipod legs on a short section of nonsealing foam pipe insulation applied to a partially rolled up vehicle window permits photographing with the camera system fully inside the vehicle (refer to Figure 6-30 in Chapter 6 to view foam pipe insulation in use). For use with digital single-lens reflex cameras, order the Roc Stoc model featuring the built-in 2-position trigger to control auto-focus and shutter release.

Figure 5-21. Subjects photographed at night from approximately 36.58 meters (40 yards) using the standard AstroScope Night Vision Module with the Canon EOS 5D digital single-lens reflex full-frame camera and Canon EF 200mm f/2.8L II USM telephoto lens. *ISO:* 200. *Aperture:* f/2.8. *Shutter speed:* 1/2 second. *Illumination:* 97 percent moon. When shutter speed is slow, record numerous sequential images so that some exposures occur when the subject pauses temporarily or when the subject is moving towards the camera. Support of the electro-optical system is required to prevent apparatus movement.

System Performance

The standard AstroScope Night Vision Modules are suitable for short- to intermediate-range night vision photography (see Figures 5-21 and 5-22). The greatest distance from which the authors have recorded subject identification (i.e., facial recognition) and legible vehicle number plates using the standard AstroScope is 289.86 meters (317 yards). A somewhat greater distance is possible. The greater magnification of the Canon EF 800mm f/5.6L IS USM telephoto lens will increase distance, but it is one stop slower than the 600mm f/4 telephoto lens.

SCT-Configured AstroScope and Special-Order Battery-Adapted AstroScope

If we could own only one image intensifier night vision device for photography, it would be the SCT-Configured AstroScope. With that model, we could do night vision photography and HD videography from short- to ultra-long-range distances. Additionally, we could use it with our Canon super telephoto lenses, with much less expensive refracting telescopes, and

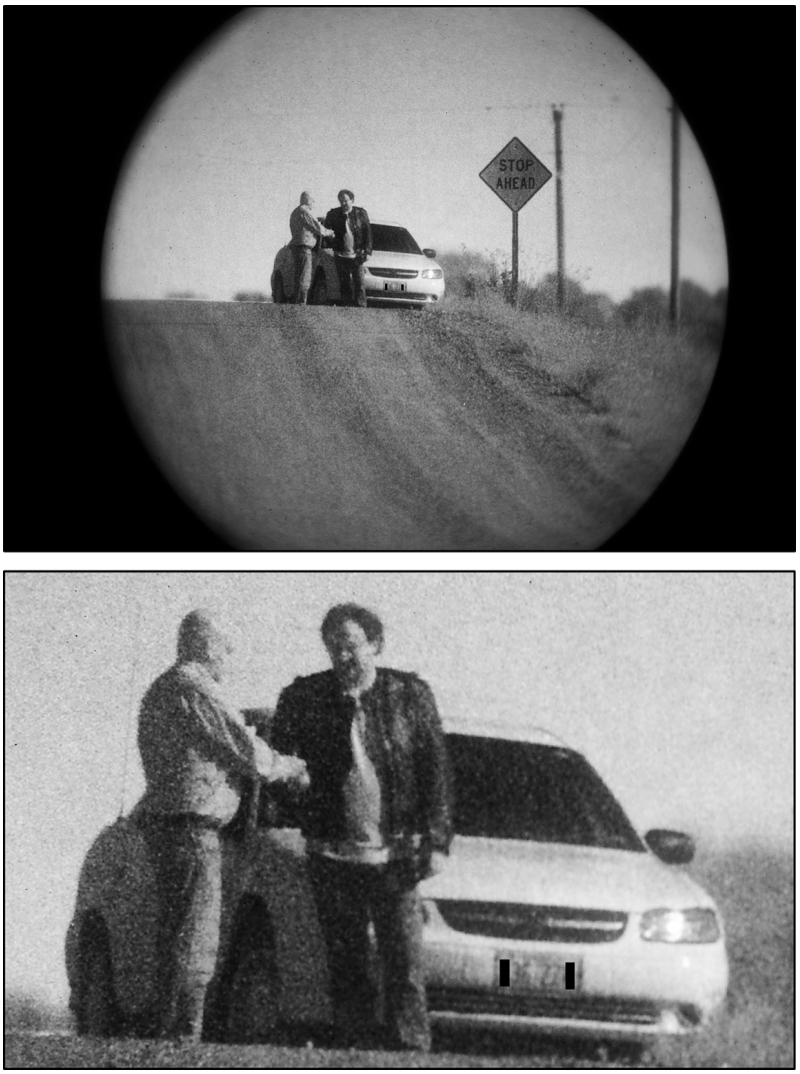

Figure 5-22. The lower image is a cropped portion of the upper image. This is the best of several images recorded of these subjects from a distance of 289.87 meters (317 yards) using the standard AstroScope Night Vision Module with a Canon EF 600mm f/4L IS USM telephoto lens and Canon EOS 5D digital single-lens reflex full-frame camera. *Illumination:* 97 percent moon. *ISO:* 100. *Aperture:* f/4. *Shutter speed:* 0.8 second. During this photo-shoot, light fog drifted into the area. This distance is near the maximum possible when using the standard AstroScope Night Vision Module with a 600mm f/4 Canon or Nikon telephoto lens. That is, for recording subject identification and legible vehicle number plates. Using the Canon EF 800mm f/5.6L IS USM super telephoto lens with the AstroScope permits a distance increase of approximately 33 percent. Hence, the 800mm lens will provide a camera-to-subject distance of approximately 366 meters (400 yards). A distance of 366 meters is about where intermediate-range night vision photography ends and long-range begins.

with high-magnification Schmidt-Cassegrain telescopes. In every respect, the SCT-Configured AstroScope does it all. (The authors)

Introduction

This section addresses the *SCT-Configured AstroScope* and the *Special-Order Battery-Adapted AstroScope* (refer ahead to Figure 5-23 and refer back to Figure 5-17). The Special-Order Battery-Adapted AstroScope will appeal to those intending to use it exclusively for long-range and ultra-long-range photography using telescopes. Those intending to use the AstroScope for short- to intermediate-range photography using Canon or Nikon electro-optical lenses, and use it with nonelectronic lenses such as telescopes for extreme distance photography, will find the SCT-Configured AstroScope most appealing. Both models permit night vision photography and HD videography using a Canon or Nikon digital single-lens reflex camera.

The Special-Order Battery-Adapted AstroScope works with refracting telescopes and with high-magnification Schmidt-Cassegrain telescopes. When using this AstroScope model with an electro-optical Canon and Nikon lens, the lens is inactive at maximum aperture and functions as a fixed aperture manual focus nonstabilized lens.

The SCT-Configured AstroScope is a high-tech user-friendly night vision device optimized for SCT-based extreme distance single image photography and HD videography. This AstroScope model works with Canon and Nikon digital single-lens reflex cameras and their dedicated electro-optical lenses. Additionally, this AstroScope works with nonelectronic lenses such as refracting telescopes and high-magnification Schmidt-Cassegrain telescopes.

Review of the AstroScope Models

The following review of the predominant features of each AstroScope model makes subsequent discussion more meaningful. While this review is perhaps redundant, the AstroScope system is the optimal night-vision photography system in existence and surveillance specialists must be familiar with the different AstroScope models presented in this chapter as they pertain to clandestine photography.

- *Standard AstroScope.* The standard AstroScope works with digital single-lens reflex (DSLR) cameras, select camcorders, and broadcast video equipment and their dedicated electro-optical lenses. The standard AstroScope, positioned between the camera and lens, permits electronic communication between the camera and dedicated electro-opti-

cal lenses and it is parasitic, meaning it receives electrical power from the camera battery. The standard AstroScope may not work with nonelectronic telescopes because camera to lens communication is absent, causing some cameras to shut down. For example, some Canon DSLR cameras display a message on the LCD monitor advising that the electrical contacts are dirty. Nikon cameras may do the same.

- *Special-Order Battery-Adapted AstroScope.* The manufacturer, Sofradir EC, Inc., provides this AstroScope model on a special order basis. When using this model, the camera is unaware of the presence of the AstroScope and telescope. That being the case, the camera attempts no communication with an electro-optical lens and therefore it functions properly in manual mode. Some surveillance specialists may prefer this model because it is noninvasive in the sense that it makes no demands of the camera. It features a battery pack containing two AAA batteries and therefore it draws no electrical power from the camera battery and neither does it interact with the functions of the camera or lens. This AstroScope works with Canon and Nikon electro-optical lenses but not in the usual manner. Because no electronic connection between the camera and lens exists, the lens is inactive at maximum aperture as if it were a fixed aperture manual focus nonstabilized lens. The lens's image stabilization, aperture control, and auto-focus features are inactive.
- *SCT-Configured AstroScope.* This high-tech, innovative, and versatile model functions in the same manner as standard AstroScopes do when placed between a DSLR camera and dedicated electro-optical lens. It permits communication between the camera and lens and therefore the normal functions of the camera and lens remain operational. Additionally, it is parasitic, meaning it receives electrical power from the camera battery. This model also works with nonelectronic lenses such as telescopes. When used with nonelectronic lenses, electronics in the special Front Lens Adapter (FLA) causes the camera to "believe" it is communicating with an electro-optical lens and therefore function in a normal manner. The SCT-Configured AstroScope provides the same ultra-long-range standoff capability provided by the Special-Order Battery-Adapted AstroScope, but it does much more.

Product Features and Capabilities

The SCT-Configured AstroScope and Special-Order Battery-Adapted AstroScope are a revolutionary night-vision photography breakthrough that provides two primary benefits. First, they permit quality long-range night vi-

sion photography using refracting telescopes that cost considerably less than Canon and Nikon super telephoto lenses. Second, they provide field personnel with an unprecedented night vision photography/videography stand-off capability. That is, they permit recording detail such as subject identification (i.e., facial recognition) and legible vehicle number plates from distances of 0.80–1.61 kilometers (0.5–1 mile), or more.

The SCT-Configured AstroScope consists of a special Front Lens Adapter (FLA) that is compatible with the Back Body Adapter (BBA) of a standard AstroScope. The manufacturer feels strongly that surveillance specialists have many priorities when performing their work in the field. They want to minimize the need for special training by making the AstroScope as user-friendly as possible. For example, they feel that specialists should not need to back-focus a relay lens, carry special batteries, or need special adapters and rings. The manufacturer designed the SCT-Configured AstroScope to be user-friendly in a way that promotes safety in the field and leaves specialists free to concentrate on the subject. Manual variable gain control is a desirable optional feature of both the SCT-Configured AstroScope and Special-Order Battery-Adapted AstroScope.

Creating a SCT-Configured AstroScope for use with Schmidt-Cassegrain telescopes (SCTs) required designing only a special Front Lens Adapter (FLA). Redesigning the entire AstroScope was unnecessary because it is a three-part modular assembly and mixing Front Lens Adapters (FLA) and Back Body Adapters (BBA) is possible (refer back to Figure 5-20 and refer ahead to Figure 5-27, lower image). Anybody who already owns a standard AstroScope must purchase only the special FLA to do SCT-based extreme-distance night vision photography. That represents a significant monetary savings.

Manual variable gain control is a function of the Central Intensifier Unit (CIU). When purchasing the SCT-Configured AstroScope for SCT-based photography, paying the extra cost for manual variable gain is justified. On the other hand, if purchasing the special Front Lens Adapter (FLA) for an existing AstroScope that does not feature manual variable gain, many surveillance specialists likely will not be willing to incur the cost of purchasing a new CIU just to acquire manual variable gain. Manual variable gain is a desirable but not essential feature and CIUs are expensive.

The hybrid methods developed by the authors, the Special-Order Battery-Adapted AstroScope, and the SCT-Configured AstroScope make

extreme-distance night vision photography possible.[7] That is, for recording detail such as subject identification (i.e., facial recognition) and legible vehicle number plates.

Although the hybrid methods presented in this chapter permit doing things that the AstroScope cannot do, they require a high level of technical expertise and setup time is greater than when using the AstroScope. Additionally, because the hybrid methods employ the afocal photography technique the specialist sees an inverted image in the camera viewfinder. The image is upside-down and revered left to right. Conversely, the AstroScope is user-friendly, capable, quick to set up, and it provides an upright image that is correct left to right.

Previously stated, the Special-Order Battery-Adapted AstroScope and the very high-tech SCT-Configured AstroScope permit recording subject identification and legible vehicle number plates from distances of 0.80–1.61 kilometers (0.5–1 mile), or more. In contrast, the hybrid methods permit photographing from a greater distance.

Point to ponder: Does the quality of an ultra-long-range daytime photograph provide insight into the distance potential of night vision photography? Study the two images in Figure 7-8 in Chapter 7 and read the caption and preceding paragraph. Sometimes, for a variety of reasons, the quality of a long-range night vision photograph is as good as or better than the quality of a daytime photograph recorded from a comparable distance.[8]

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7. The AstroScopes configured for SCT-based photography are user-friendly innovations that make extreme distance photography possible. Nevertheless, for three reasons these AstroScope models do not eliminate the need for the hybrid methods developed by the authors and presented later in this chapter. First, the AstroScope system is not available to surveillance specialists in all countries. Surveillance specialists without access to the AstroScope need the hybrid methods for use with a night vision monocular. Second, specialists who have a night vision monocular and cannot afford an AstroScope need the hybrid methods. Third, the hybrid methods permit doing things that AstroScope products cannot do (e.g., hybrid methods provide tremendous latitude for increasing and decreasing magnification and for configuring exceptionally fast optical systems for unusually dark night photography–refer back to Figure 5-14).

8. If asked from how far they can photographically record detail such as recognizable images of people and legible vehicle number plates during daylight hours using daytime optics, and at night using image intensifier night vision technology, the authors would admit they do not know. Their maximum range exceeds any distances from which they have had occasion to record such detail in the past, day or night. It is a matter of optics, atmosphere, nature of the lighting, and method. Certainly, though, maximum distance would fluctuate by season, day, and hour because of variables. During a rainstorm, one cannot record useful photographic images from any appreciable distance. During mid-summer in Phoenix, Arizona (USA), a hot desert region, camera-to-subject distances are considerably less than they are in Great Falls, Montana (USA) during the month of January when it is very cold. Lighting direction and intensity also determines the distance from which recording essential detail is possible, especially when photographing with an image intensifier night vision device. Extreme distance daytime photography is fraught with variables with night vision photography even more affected by variables. Extreme distance night-vision photography is highly unforgiving.

F/6.3 Focal-Reducer and 1.4x Tele-Converter for AstroScope Photography

Introduction

The f/6.3 focal-reducer decreases magnification and increases effective f-ratio, accomplishing that by making the image smaller and brighter. A tele-converter increases magnification and reduces effective f-ratio, accomplishing that by making the image larger and dimmer. The f/6.3 focal-reducer and 1.4x tele-converter are essential optical accessories when using a Schmidt-Cassegrain telescope (SCT) for extreme distance daytime photography, nighttime high ISO available light photography, and for night vision photography.

The Special-Order Battery-Adapted AstroScope supports the following discussion (see Figure 5-23 and refer back to Figure 5-17).

F/6.3 Focal-Reducer for AstroScope Photography

Celestron and Meade Instruments Corporation provide an f/6.3 focal-reducer. The focal-reducer is an essential optical accessory when using a Schmidt-Cassegrain telescope (SCT) for extreme distance daytime photography, nighttime high ISO available light photography, and for night vision photography using afocal coupling or using an AstroScope configured for SCT-based photography (refer back to Figure 5-23, upper and lower images, and refer to Chapter 2, subheading *F/6.3 Focal-reducer Corrector Lens*).

The f/6.3 focal-reducer designed for use with SCTs provides the means to accomplish the following:

- Increase effective f-ratio–makes the optical system faster by an amount equal to 1 1/3 stops. For night vision photography, a gain of 1 1/3 stops is significant and often essential. The focal-reducer increases the f-ratio of an f/10 SCT to f/6.3 although at reduced magnification.
- Reduce magnification by 37 percent.
- Increase field-of-view by 63 percent. It accomplishes that by placing a greater portion of the scene onto the camera image sensor (refer ahead to Figure 5-24).
- Minimize the field curvature characterizing Schmidt-Cassegrain telescopes and thus improve edge-of-field clarity. *Note:* Refer subheading *F/6.3 Focal-Reducer and Flat Field Catadioptric Telescopes* in Chapter 2. Celestron and Meade report that the f/6.3 focal-reducer is incompatible with their flat field telescopes. However, for clandestine applications, it may work (but it may not work)–it warrants experimentation.

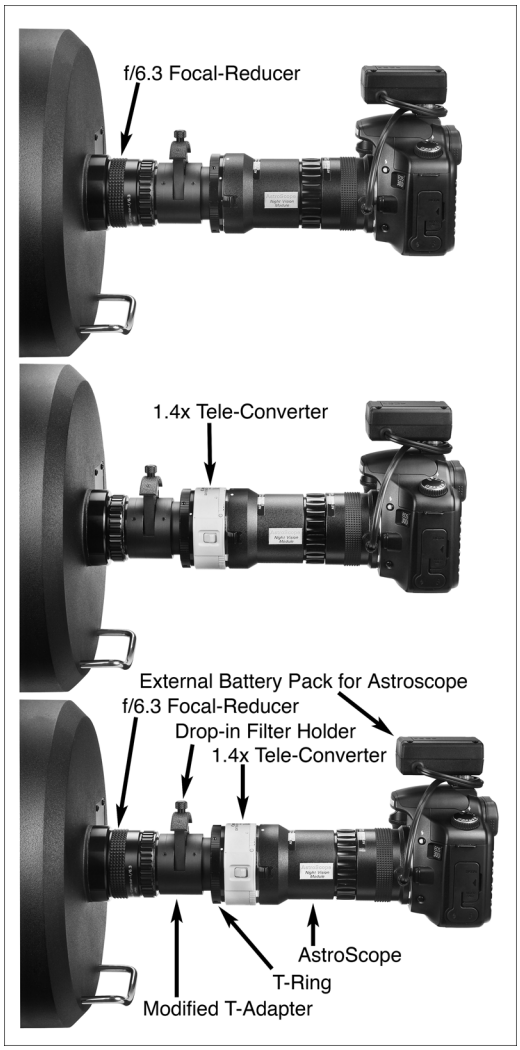

Figure 5-23. This Special-Order Battery-Adapted AstroScope works with nonelectronic lenses such as refracting telescopes and high-magnification Schmidt-Cassegrain telescopes (SCTs), the 2350mm f/10 Celestron C9.25″ SCT illustrated here. When used with an electro-optical Canon (or Nikon) lens, this AstroScope model provides no electronic connection between the camera and lens. Therefore, the lens is inactive at maximum aperture as if it were a fixed aperture manual focus nonstabilized lens (i.e., the telephoto lens functions like a refracting telescope). This AstroScope model requires an external battery pack containing two AAA size batteries. The battery pack slides into the camera hot shoe receptacle simply as a convenient place to secure it. The T-Adapter is an in-house modified version designed to accept drop-in neutral density (ND) filters. Schmidt-Cassegrain telescopes (SCTs) feature no variable diaphragm to control light passage. Therefore, when the level of ambient illumination is excessive, the surveillance specialist uses a neutral density (ND) filter to reduce the amount of light reaching the faceplate of the NVD intensifier tube. The professional grade Canon EOS-1D Mark IV DSLR camera illustrated here permits recording high-definition (HD) video.

The f/6.3 focal-reducer increases field-of-view by reducing the size of the image circle and thereby including all or more of the image circle on the camera's image sensor. However, the reducer cannot increase the field-of-view beyond the angle-of-view of the telescope. The camera cannot record more than the telescope sees. Because the f/6.3 focal-reducer increases field-of-view by reducing the size of the image, it simultaneously reduces magnification (see Figure 5-24).

The f/6.3 focal-reducer increases effective f-ratio by reducing the size of the image circle, which increases the brightness of the image; more light concentrated in a smaller area. As the brightness of the image reaching the faceplate of the intensifier tube increases, tube gain automatically decreases. As gain decreases, image quality increases by virtue of reduced scintillation. Scintillation appears as grain, electronic noise, a random sparkling effect throughout the image area (Morovision Night Vision, Inc., 2010, n.p., *Scintillation*). *Observation:* When recording the images in Figure 5-24, it was very dark and automatic tube gain likely was at or near maximum. When recording the image in Figure 5-26 it was very light and tube gain was low, likely at or near minimum. Compare the quality of the images.

F/6.3 Focal-Reducer and 1.4x Tele-Converter: Simultaneous Use

> When using an f/6.3 focal-reducer and a 1.4x tele-converter together with a Schmidt-Cassegrain telescope magnification decreases by approximately 13 percent and the effective f-ratio increases by about 1/3 stop.

It is possible to use an f/6.3 focal-reducer and a 1.4x tele-converter together to split the difference between either used alone. Nonclandestine photographers would never do this, but clandestine photographers do whatever is required to record usable photographic images under difficult field conditions. A reduced quality image is better than no image.

During night vision photography, the ability to manipulate magnification and effective f-ratio is paramount. How the specialist accomplishes that is irrelevant. Remember, the clandestine photographer works with criteria that are very different from that of photographers practicing other types of photography. A wildlife photographer, for example, would not combine a focal-reducer and tele-converter.

The specialist recorded the upper image in the previous illustration using a Schmidt-Cassegrain telescope (SCT) with an f/6.3 focal-reducer. The focal-reducer increased the effective f-ratio from f/10 to f/6.3 (1 1/3 stops) and it reduced magnification by 37 percent. Sometimes, however, the specialist needs to reduce magnification but not by as much as 37 percent. Similarly, a need often exists to increase the effective f-ratio but a 1 1/3 stop gain is not

Figure 5-24. Night vision images recorded from a distance of 0.55 kilometer (0.34 mile) using the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) with and without the Celestron f/6.3 focal-reducer. The focal-reducer provides an effective f-ratio gain of 1 1/3 stops, an increase from f/10 to f/6.3. The f/6.3 focal-reducer also increases field-of-view. It increases field-of-view by reducing the size of the image circle and thereby placing more of the image onto the camera image sensor. The reducer will not increase field-of-view beyond the angle-of-view of the telescope. The surveillance specialist used the Special-Order Battery-Adapted AstroScope to record these images. *Upper image:* Image recorded without a focal-reducer using ISO 100 and 1.5-second exposure duration. Focal length and f-ratio 2350mm f/10 (47x magnification). *Lower image:* Image recorded with a Celestron f/6.3 focal-reducer using ISO 100 and 1/3 second exposure duration. Effective focal length and f-ratio 1480mm f/6.3 (29.61x magnification). The specialist recorded these images on a very dark night with little light falling onto the subject, which affected image quality. The Automatic Brightness Control (automatic intensifier tube gain) feature of the intensifier tube probably was at or near maximum, which increased scintillation and thus reduced image quality. Another factor diminishing subject identification (i.e., facial recognition) may have been the night vision device automatically adjusting gain in response to brighter portions of the scene (e.g., white car and distant lights) which darkened the subject and thereby diminished subject identification (refer ahead to Figure 5-52). Often, the specialist doing night vision photography must manage illumination extremes. Remember, a third generation (Gen 3) night vision device features a brightness gain of approximately 40,000x and it features limited dynamic range.

Figure 5-25. Night vision image recorded from a distance of 0.39 kilometer (0.24 mile) using a Canon crop-sensor digital single-lens reflex camera, 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope, f/6.3 focal-reducer and Canon 1.4x tele-converter (refer back to Figure 5-23, lower image). *Effective focal length and f-ratio:* 1323mm f/8.82 (26.46x magnification). *Night vision device:* Special-Order Battery-Adapted AstroScope. *ISO:* 100. *Shutter speed:* 1/2 second. *Illumination:* Artificial lighting in the area, half moon, and stars. Dried foliage in the line-of-sight prevented recording a legible vehicle number plate. Select vantage points with care to prevent visual obstructions although in some instances that is not possible.

necessary. In such instances, using an f/6.3 focal reducer and a 1.4x tele-converter together may provide the required degree of magnification and f-ratio change.

When using an f/6.3 focal-reducer and a 1.4x tele-converter together with an SCT, magnification decreases by approximately 13 percent and the effective f-ratio increases by about 1/3 stop (see Figure 5-25). Multiplying the focal length and f-ratio of the SCT by 0.882 provides the effective focal length and f-ratio (e.g., 1500mm f/10 x 0.882 = 1323mm f/8.82).

Combining an f/6.3 focal-reducer with a 1.4x tele-converter, using them together, diminishes image resolution and contrast. It is likely, however, that the diminished resolution is still greater than the resolution of a third-generation (Gen 3) image intensifier night vision device (NVD). Resolution tests under controlled conditions would confirm or disprove this hypothesis. Contemplate this with the understanding that the resolution of a Gen 3 image intensifier NVD approximates the resolution of a 3 megapixel digital camera.

The resolution of a Gen 3 NVD is 57 lp/mm minimum, 64 lp/mm typical. If the diminished resolution caused by using a focal-reducer and tele-converter together exceeds the resolution of a Gen 3 NVD (exceeding the resolution of a 3-megapixel camera), little or nothing is lost. At any rate, during extreme distance photography using an image intensifier night vision device, the surveillance specialist often needs the means to manipulate magnification and f-ratio and will (must) accept sacrifice to accomplish that (refer to Figures 4-63 and 4-64 in Chapter 4).

1.4x Tele-Converter for AstroScope Photography

Quickly locating distant subjects during extreme-distance night vision photography requires using a night vision finder scope.

Previous discussion addressed using the f/6.3 focal-reducer alone, and it addressed using an f/6.3 focal-reducer and a 1.4x tele-converter together. This discussion addresses using a 1.4x tele-converter alone with an AstroScope and a Schmidt-Cassegrain telescope (SCT). When distance exceeds the magnification capability of the SCT in use, either use a larger SCT or increase the magnification of the existing SCT by placing a 1.4x tele-converter between the AstroScope and the T-Ring. That will increase the effective focal length by 40 percent (see Figure 5-26 and refer back to Figure 5-23, center image).

Regarding the above illustration, from that distance using the 3048mm f/10 12″ Meade LX90-SC, LX90-ACF, or LX200-ACF telescope without a tele-converter would provide better image quality. In comparison to the optical configuration used to record the above image, those telescopes are one stop faster, focal length is only 8 percent shorter, and light would pass through no tele-converter glass. A tele-converter somewhat reduces resolution and contrast. Additionally, their 12-inch (304.8 millimeters) aperture gathers considerably more light and provides better resolution than the 9.25-inch (234.95 millimeters) aperture of the telescope used to record that image.

For additional information about tele-converter and focal-reducer use, and the feasibility of using them together, refer to the subheading *Manipulating Magnification and F-Ratio: Four Schmidt-Cassegrain Telescopes in One* at the end of Chapter 4.

Managing Ambient Illumination

The surveillance specialist recorded the night vision images in the previous two illustrations with the benefit of artificial lighting in the area of the subject. Artificial lighting is an environmental condition that surveillance

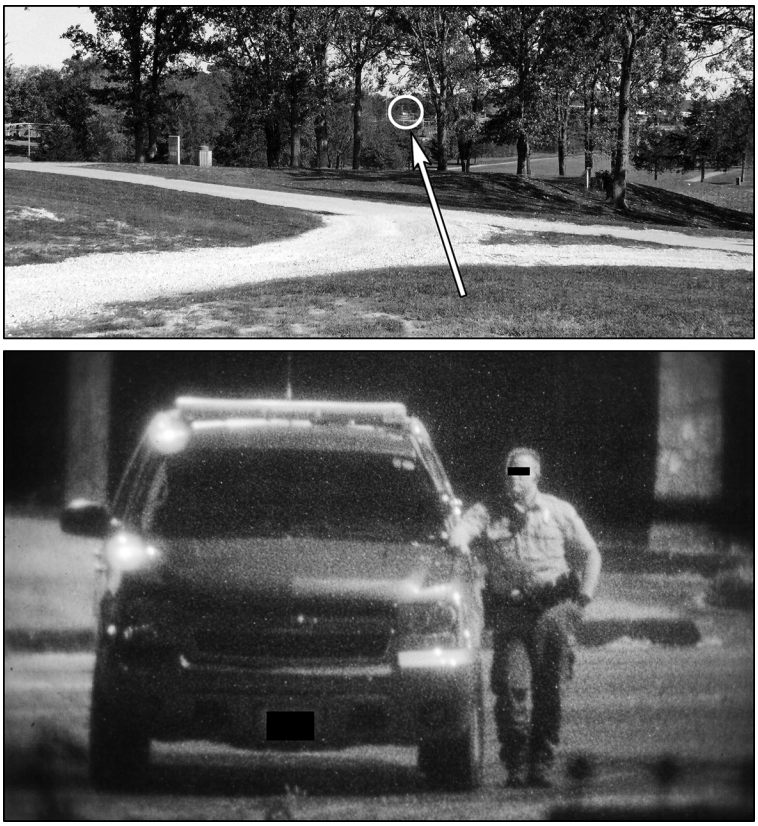

Figure 5-26. Night vision image recorded from a distance of 0.87 kilometer (0.54 mile) using the Special-Order Battery-Adapted AstroScope with the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope and a Canon 1.4x tele-converter. The circle in the upper overview daytime image identifies the subject location; the trees provide cover. *Effective focal length and f-ratio:* 3290mm f/14 (66x magnification). *ISO:* 100. *Shutter speed:* 1/20 second. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Illumination:* Artificial lighting in the area, overcast sky, no moon. The illumination level of this scene was bright enough that the Automatic Brightness Control (automatic intensifier tube gain) feature of the intensifier tube probably was at or near minimum, which reduced scintillation and thus enhanced image quality (compare this image with the image in Figure 5-24). The angle-of-view of the optical system used to record this image was approximately 0.26 degrees. Quickly locating distant subjects during extreme-distance night vision photography requires using a night vision finder scope (refer back to Figure 5-17). This illustration verifies that the "ideal" optical configuration is not always essential for recording usable surveillance images, this being an important point for those working within a limited budget.

specialists can sometimes manipulate as needed for a long-term stakeout requiring night vision photography. Alternatively, they illuminate the subject using an infrared (IR) illuminator.

The two previous illustrations provide an example of an illumination level permitting short-range high ISO fast-lens available light photography without a night vision device, but an illumination level requiring a night vision device when photographing from an extreme distance. Short and fast lenses in this instance are the Canon and Nikon 200mm f/2, 300mm f/2.8, and 400mm f/2.8 telephoto lenses. Photographing the same subject from a long distance requires ultra-high magnification, which results in a comparatively slow optical system. The slow optical system requires using a night vision device to increase image brightness (refer ahead to Figure 5-50).

Concluding Observation

Historically, not many law enforcement agencies and private investigators purchased night vision devices for manual clandestine photography. Night vision devices are expensive and, perhaps, many potential users felt the cost was unjustified because of the limited standoff capability that was possible at the time. Fortunately, inadequate standoff distance is no longer a problem.

The hybrid methods discussed shortly provide the ultra-long-range photography standoff capability necessary to justify the price of a Gen 3 image intensifier night vision monocular. The SCT-Configured AstroScope will work with virtually all electro-optical Canon and Nikon telephoto lenses and it will work with nonelectronic lenses such as refracting telescopes and Schmidt-Cassegrain telescopes. Hence, the SCT-Configured AstroScope will work for short-range to ultra-long-range photography and videography.

Modern digital single-lens reflex (DSLR) cameras featuring Full HD movie mode with manual exposure control significantly enhance the value of AstroScopes configured for SCT-based photography considering what the surveillance specialist can accomplish with them. They permit a level of night vision photography and videography unimaginable not long ago. From a cost/benefit standpoint, the AstroScopes configured for SCT-based photography represent excellent value.

Focal-Reducers for Refracting Telescopes

Previous discussion addressed the f/6.3 focal-reducer designed specifically for use with Schmidt-Cassegrain telescopes (SCTs), the reducer working with any size SCT made by any manufacturer. Unfortunately, the f/6.3 focal-reducer does not work with refracting telescopes. Focal-reducers for refracting telescopes do exist, but they are telescope specific meaning that each reducer works only with a specific telescope model. The article *Focal Reducers,* in Skies Unlimited (2011, n.p.), explains that, "Focal-reducers for

refractors must be matched to the focal length of the instrument due to the relationship between focal length and field curvature. Some refractors, notably the TeleVue 'NP' or Nagler-Petzval and Takahashi 'FSQ' have inherently flat fields and should not be used with standard focal-reducers."

AstroScope for Night Vision Videography

> Certainly, surveillance specialists can use high-magnification optics with a camcorder but they must be aware of the magnification versus field-of-view limitation.

At the time of this writing, two recent technologies have revolutionized night vision photography and videography by providing an extreme stand-off capability. They are the AstroScopes configured for SCT-based night vision photography and digital single-lens reflex (DSLR) cameras that record high-definition (HD) video.

When long-range maximum quality night vision videography is necessary, use one of the AstroScopes configured for SCT-based photography. Use it with a high-magnification Schmidt-Cassegrain telescope (SCT) and a DSLR camera capable of recording HD video. Both Canon and Nikon offer full-frame and crop-sensor DSLR cameras capable of recording HD video. Regarding the remarkable video capture capability of the Canon EOS 5D Mark II full-frame DSLR camera, Canon explains:

> With the introduction of the EOS 5D Mark II, Canon revolutionized the video industry with the ability to shoot Full HD video on a 24mm x 36mm sensor. . . . Canon is pleased to announce a free downloadable firmware update that enables manual exposure controls while shooting video including: ISO, aperture and shutter speed. . . . This update transforms the Canon EOS 5D Mark II into the first full frame 24mm x 36mm DSLR with manual exposure video control, creating an amazing tool for the video and motion picture industries alike. . . . (Canon U.S.A., Inc., 2011, n.p., *EOS 5D Mark II Firmware Upgrade*)

Another factor favoring the use of DSLR cameras for night vision videography is their tolerance to elevated ISO when recording night vision images. That is important because recording moving video images at 30 frames per second requires using a shutter speed faster than 1/30th of a second, which sometimes requires increasing ISO. Recording night vision moving video images sometimes requires filming at less than 30 frames per second, or using an infrared (IR) illuminator, or both. Refer to the information under subheading *Infrared Illuminators* towards the end of this chapter.

Figure 5-27. The AstroScope model 9350BRAC permits combining noninterchangeable lens camcorders with telephoto lenses made for digital single-lens reflex (DSLR) cameras (e.g., Canon and Nikon lenses). This particular AstroScope accepts camcorders featuring 43-millimeter filter threads although the manufacturer, Sofradir EC, Inc., offers variants of this model that accept other size filter threads. In some instances, mounting a camcorder to this AstroScope in the manner shown here requires using step up/down adapter rings. As shown here, two methods exist for using DSLR camera lenses (and telescopes) with this AstroScope. First, the surveillance specialist can take the Front Lens Adapter (FLA) made for DSLR camera lenses and combine it with the Back Body Adapter (BBA) of the AstroScope model 9350BRAC as shown in the lower image. The BBA in the upper and lower image is the same one–the specialist just switched FLAs. Second, shown in the upper image, the specialist can use a C-Mount adapter. Without a support bracket, stress on the C-Mount threads is considerable. The Canon EOS C-Mount Adapter is available from Stellar Technologies International which provides a similar adapter for Nikon lenses (www.stellar-international.com). In both the configurations illustrated here, the automatic functions of the Canon lens are inactive. That is, lack of an electronic connection to a DSLR camera leaves the lens's image stabilization, autofocus, and aperture control inoperable. The lens is inactive at maximum aperture as if it were a fixed aperture manual focus nonstabilized lens. All functions of the camcorder, however, remain operational. Illustrated is the Canon EF 300mm f/2.8L IS USM telephoto lens and Canon VIXIA HV30 HD camcorder.

In addition to using a DSLR camera featuring HD video capture, there are several ways to configure AstroScope Night Vision Modules for use with camcorders (see Figures 5-27 and 5-28). For long-range night vision videography, the AstroScope 9350BRAC offers a couple of methods for combining camcorders with telephoto lenses made for digital single-lens reflex cameras, two methods shown in the following illustration. These methods also permit mounting the camcorder and AstroScope to a high-magnification Schmidt-Cassegrain telescope.

Figure 5-28. The AstroScope Night Vision Module accommodates select camcorders and broadcast video equipment. The AstroScope makes this Canon XL Series digital camcorder a night vision system featuring the optically stabilized 5.4-108mm 20x Video Zoom lens. The 35mm equivalent focal length of the lens relative to angle-of-view (not magnification) is 38.9–778mm. Image courtesy of Electrophysics Corporation, a Sofradir Group Company.

Relative to magnification versus field-of-view, the surveillance specialist can record detail such as subject identification (i.e., facial recognition) and legible vehicle number plates from greater distances using a DSLR camera in the HD video capture mode than is possible when using a camcorder. That is because the large image sensor of DSLR cameras permits using high magnification optics and still have adequate field-of-view.

Camcorders contain a small image sensor and therefore field-of-view is a limiting factor when using high-magnification telephoto lenses and telescopes. The problem is that magnification sufficient to record essential detail sometimes results in field-of-view being inadequate. Experiment with the AstroScope using each camera, camcorder, lens, and optical accessory to become familiar with field-of-view results.

Certainly, surveillance specialists can use high-magnification optics with a camcorder, but they must be aware of the magnification versus field-of-view limitation. In spite of their limitations, camcorders remain useful for

night vision videography because they are comparatively inexpensive, small, lightweight, and they permit recording uninterrupted for extended periods.

View the various AstroScope models by visiting the manufacturer's website and the website of their United States distributor, Morovision Night Vision, Inc. Sofradir EC, Inc. (www.nightvisioncameras.com). Morovision Night Vision, Inc. (www.morovision.com). *Note:* In conformance with International Traffic in Arms Regulations (ITAR), Morovision Night Vision, Inc. does not ship night vision products outside the United States.

Neutral Density Filters for Long-Range SCT-Based AstroScope Photography

> . . . during night vision photography, every "night" is different in terms of conditions and ambient light levels. Additionally, certain camera settings may work well in some situations but not in others. For those reasons, having as many adjustment options as possible in order to adapt to each situation is the best solution. (Morovision Night Vision–Marketing, personal communication, April 8, 2010)

When using the standard AstroScope and the SCT-Configured AstroScope with a Canon or Nikon telephoto lens, aperture control is active. The surveillance specialist can control the aperture of the lens and thereby control the amount of light reaching the faceplate of the image intensifier tube of the night vision device (NVD). When using the Special-Order Battery-Adapted AstroScope with a Canon or Nikon telephoto lens, the lens is inactive at maximum aperture because no electronic connection between the camera and lens exists. The specialist cannot control the aperture of the lens to increase and decrease the amount of light reaching the faceplate of the intensifier tube of the NVD. Likewise, when using the SCT-Configured AstroScope or the Special-Order Battery-Adapted AstroScope with a Schmidt-Cassegrain telescope (SCT), no means to control aperture exists because SCTs feature no variable diaphragm.

When controlling the amount of light reaching the faceplate of the NVD intensifier tube is not possible by means of aperture control, the specialist manages light by using neutral density (ND) filters. ND filters feature uniform density and therefore they reduce the brightness level of all colors equally.

During night vision photography using an AstroScope with a Schmidt-Cassegrain telescope (SCT), several conditions require using a neutral density (ND) filter to reduce the intensity of the light reaching the faceplate of the intensifier tube of the NVD. The conditions include the following:

- Traditionally, there was a time during morning and evening when manual clandestine photography could not occur. That was because there was a period twice a day when the level of natural illumination was too low for high ISO available light photography but too bright for image intensifier night vision photography. Today, the exceptionally high ISO capability of DSLR cameras and their tolerance to underexposure make available light photography possible under a lower level of illumination than previously was possible. Combine that with neutral density filters making night vision photography possible under conditions otherwise too bright and the photographer can photograph under any illumination level. No longer is there a level of illumination twice a day that renders manual clandestine photography impossible.
- The level of artificial illumination in the area of the subject can be too low for high ISO available light photography but too bright for night vision photography. Using an appropriate neutral density (ND) filter to reduce the amount of the light reaching the faceplate of the intensifier tube of the NVD permits photography under the circumstances. The level of illumination determines what density of ND filter to use. ND filter densities range from one stop to 20 stops of light reduction.
- Sometimes the level of artificial illumination is such that minimum manual variable gain of the NVD is necessary. In that circumstance, having to use minimum gain leaves the specialist without the means to find the so-called variable gain sweet spot. By using an appropriate density ND filter in such instances, the specialist can increase the level of manual variable gain to find the camera ISO and NVD manual variable gain levels that together optimize image quality while providing a suitably fast shutter speed.

Most lenses for DSLR cameras feature filter threads that permit screwing a filter to the front of the lens. The exception is several Canon and Nikon super telephoto lenses featuring large diameter objective lenses. Instead of filter threads at the front of the lens, a slot towards the rear (camera end) of the lens accepts a drop-in (slip-in) filter holder. For example, the Canon and Nikon 600mm f/4 super telephoto lenses accept a filter holder to which one screws standard 52-millimeter filters. The photographer screws a filter to the filter holder and then inserts the filter holder into the slot located towards the camera end of the telephoto lens.

For long-range photography using the AstroScope with a Schmidt-Cassegrain telescope, the specialist needs a T-Adapter that accepts drop-in filters (refer back to Figure 5-23). Nobody manufactures such a T-Adapter so in-

house or contract fabrication is necessary. Fortunately, creating a custom T-Adapter to accept drop-in filters is easy whether modifying an existing T-Adapter or fabricating an entirely new one.

Whether fabricating a new T-Adapter or modifying an existing adapter, consider whether it should accept a Canon or Nikon drop-in filter holder or accept an in-house fabricated filter holder. If fabricating a filter holder in-house, instead of cutting threads to accept screw-in filters, consider designing it to accept a macro-reversing ring featuring female threads. The reversing ring in turn accepts screw-in filters (www.macrorings.com). Another possibility is to make a filter holder that accepts gelatin filters.

The authors' in-house fabricated T-Adapter accepts a Nikon filter holder that extends above the adapter (refer back to Figure 5-23). Ideally, the shroud should cover the slot to exclude extraneous light as Nikon intended. When using this modified T-Adapter in an illuminated area, wrapping an opaque cloth around the adapter to exclude extraneous light is necessary. Alternatively, use black Gaffer tape to prevent extraneous light entering the modified T-Adapter. Another solution is to fabricate a secondary shroud for the filter holder to exclude extraneous light.

The ideal AstroScope T-Adapter would be one featuring a built-in revolving filter wheel containing four different neutral density (ND) filters and one open hole for unfiltered photography, or a hole containing a UV haze filter. Such a filter wheel would eliminate the need to carry a supply of filters, it would permit quickly and easily selecting the filter density most appropriate for the level of ambient illumination, and it would exclude dirt and extraneous light. Astronomers use filter wheels so this concept is not new. If constructing a T-Adapter featuring a filter wheel, consider making it to accept neutral density filters and a #87 infrared filter to prevent blooming around fluorescent light bulbs.

MONOCAM NIGHT VISION CAMERA SYSTEM

A circumstance that requires photographing a subject from short range begs use of the Monocam because DSLR cameras are loud and their sound is distinctive.

Introduction

The Monocam combines the PVS-14 or MV-14 type image intensifier monocular night vision device with the 14 Megapixels Olympus Stylus Tough-8010 Digital Camera, a pocket camera. Under the title *MONOCAM™ Digital Camera Adapter Kit,* Morovision Night Vision, Inc. (2010, n.p.) ex-

plains that, "Originally designed for rugged military use, the waterproof, freezeproof, shockproof & dustproof MONOCAM™ Night Vision Camera Adapter Kit combines the latest developments in digital camera technology with the best in U.S. manufactured night vision technology."

Pros and Cons

- ***Pros:***
  - User friendly.
  - Compact.
  - Lightweight.
  - Provides user mobility.
  - Durable and waterproof.
  - Quiet operation (virtually soundless).
  - Shutter produces no image degrading vibration.
  - Manual control of ISO.
  - VGA, 30fps movie mode.
  - Afocal coupling permits long-range and ultra-long-range photography.
  - Adaptable to the BushHawk Shoulder Mount and to the Morovision Roc Stoc Tactical Shoulder Stock Rail Interface system.
  - Adaptable to Kenyon gyrostabilizers.
  - The image intensifier night vision devices used with this system are suitable also for direct viewing and for other night vision photography applications. That adds to the attractiveness and affordability of this system.
- ***Cons:***
  - This product is not available to surveillance specialists in all countries.
  - The camera lens is comparatively slow, f/3.5-5.1. Nevertheless, that is not a problem during long-range afocal photography wherein the f-ratio of the optical system is less than the small aperture of the camera lens.
  - Consumer reviews of the camera suggest good but not exceptional image quality. Nevertheless, camera resolution exceeds the resolution of a Gen 3 image intensifier night vision device (NVD). The resolution of a Gen 3 NVD is comparable to that of a 3 megapixel digital camera.
  - The camera features a small size image sensor, which results in diminished field-of-view during afocal coupling.

  - Shutter lag–compact digital cameras tend to feature shutter lag, which can prevent capturing a brief decisive moment. Consumer reviews suggest the Tough-8010 camera features notable shutter lag.
  - Consumer reviews suggest that camera startup time is slow by industry standards and that a long delay exists between exposures.
  - The camera features no aperture or shutter priority mode.
  - In some instances, light from the camera LCD monitor can betray the user's presence, but the surveillance specialist can manage that risk.
  - Dual image stabilization–mechanical and digital. Digital image stabilization is not true stabilization because it reduces image blur by increasing ISO, which in turn degrades image quality, especially when photographing with a night vision device.
  - For night vision photography, the camera is not tolerant of increased ISO.
  - The camera does not accept a remote shutter release, which requires in-house or contract fabrication of a mechanical shutter release adapter (refer ahead to Figures 5-31a and 5-32).
- ***Best Uses:*** Short- to long-range night vision photography under good nighttime illumination. Afocal coupling to achieve high magnification usually results in an effective f-ratio slower than the speed of the Olympus lens so, in that respect, the slow speed (small aperture) of the camera lens is of no consequence. *Note:* With full moon illumination, the authors conducted an experiment. They found they could use a faster shutter speed and record better image quality with the Canon EOS 5D digital single-lens reflex full-frame camera and f/2 lens at ISO 6400 than they could with the Monocam night vision camera system at ISO 100. Nevertheless, the camera without a night vision device provided no visible image to use for focusing, framing, and exposure selection, which was a serious limitation. For handheld use, consider mounting the Monocam to a Kenyon KS-6 or KS-8 gyrostabilizer (refer back to Figure 5-15 and refer ahead to Figure 5-31a, lower image). Gyrostabilizers are expensive but worth the cost.

Application Methods

The Monocam Night Vision Camera Adapter permits using the Olympus Stylus Tough-8010 Digital Camera for short- to ultra-long-range night vision photography. The optical configuration determines effective camera-to-subject distance (see Figures 5-29 to 5-33). As Olympus replaces each Stylus Tough camera model with a new version, the manufacturer of the Monocam Adapter modifies it accordingly.

Figure 5-29. Monocam night vision camera system with the Olympus Stylus 1030 SW pocket camera and the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device fitted with the Mil-Spec (military specifications) f/2.4 5x extension magnification lens. The latest Monocam accepts the Olympus Stylus Tough-8010 Camera which supersedes the Olympus Stylus 1030 SW shown here.

One of the benefits of the small and compact Monocam night vision camera system is lack of sound and lack of vibration when recording images. The camera features a combined mechanical and electronic shutter that is vibration free and quiet. The quiet shutter permits photographing subjects from close range. Discussed in Chapter 2, outside at night, the distinctive sound of a digital single-lens reflex camera is audibly detectable from 91.44 meters (100 yards) or more.

Understand the limitation imposed by the relatively slow lens of the Olympus Stylus Tough-8010 camera, but do not reject the Monocam night vision camera system on that basis. All systems for night vision photography feature shortcomings. On the positive side, the night vision devices compatible with the Monocam system are adaptable to digital single-lens reflex cameras and camcorders, and they are useful for direct viewing. Possession of the Monocam™ will enhance night vision photography options.

PHOTOGRAPHY USING A MONOCULAR NIGHT VISION DEVICE

Afocal coupling for long-range night vision photography is most appropriate for static surveillance, situations wherein the surveillance specialist sets up at a distant vantage point to photograph activity at a specific location.

Figure 5-30a. Both images recorded from 66.75 meters (73 yards). The upper image is a daytime image and the lower image is a night vision image. Lower image recorded using the Monocam night vision camera system with the Olympus Stylus 1030 SW compact digital camera and the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device with the Mil-Spec (military specifications) f/1.5 3x extension magnification lens. Zoom lens of the Olympus camera set at 7mm. *ISO:* 100. *Aperture:* f/4.1. *Shutter speed:* 1/2 second. *Illumination:* 33 percent moon. Human subjects require increasing ISO to achieve a faster shutter speed or using an infrared (IR) illuminator.

Figure 5-30b. This is the house appearing in the previous illustration recorded from the same location using the same Monocam camera system but with the Mil-Spec (military specifications) f/2.4 5x extension magnification lens on the night vision device. *ISO:* 100. *Aperture:* f/4.1. *Shutter speed:* 1/2 second. The zoom lens of the Olympus camera was set at 7mm. *Illumination:* 33 percent moon. This is a useful image although it lacks edge-of-field clarity; subjects must be in the central area of the frame.

Introduction

The information in this section is valuable because it pertains to virtually any high quality monocular night vision device regardless of make, model, and country of origin. Therefore, surveillance specialists in virtually all countries will find the information in this section usable.

This section features the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device and its predecessor the NQPVS-14 Gen 3 monocular night vision device. They both operate on the principle of image intensification (i.e., light amplification). ITT Night Vision, located in Roanoke, Virginia (USA), manufactured both products. Although the manufacturer designed these night vision devices for multiple direct viewing applications, they are high performers when camera adapted and used with proper technique.

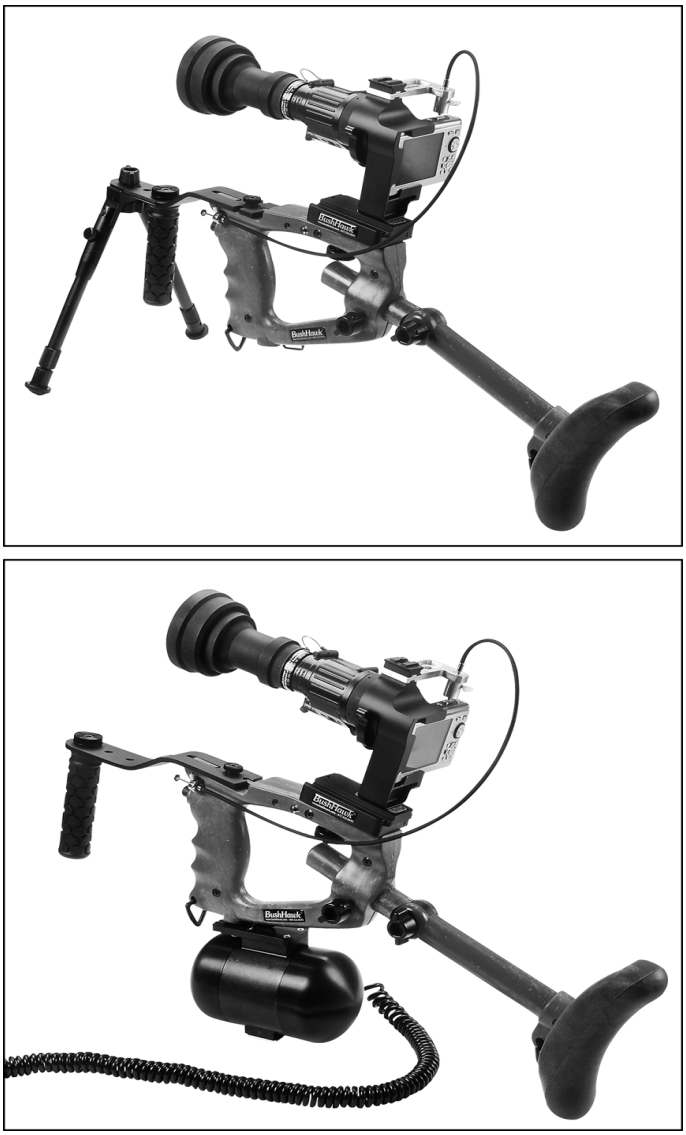

Figure 5-31a. Night vision photography usually involves a comparatively slow shutter speed and that requires camera stability. *Upper image:* Monocam night vision camera system on the BushHawk Shoulder Mount with the optional folding bipod. *Lower image:* Using one Kenyon KS-8 gyrostabilizer provides stabilization on two axes–pan and tilt (battery pack and inverter not shown). In both images, the BushHawk features the Arca-Swiss style Quick Release Base and Plate, a worthwhile optional accessory. In-house or contract fabrication of the mechanical cable release adapter is necessary. In both images, the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device is fitted with the Mil-Spec (military specifications) f/2.4 5x extension magnification lens.

Figure 5-31b. 24/7 Recon R/T Scope Kit set up for low-light digital photography using the Monocam night vision camera system. The current Monocam system features the Olympus Stylus Tough-8010 Digital Camera. The aperture range of the camera being f/3.5-5.1 (wide angle to telephoto) and the scope being 185.5mm f/3.71 makes them a compatible combination for recording intermediate range still images and short duration video. For product details, visit the website of Morovision Night Vision, Inc. (www.morovision.com). Image courtesy of Morovision Night Vision, Inc.

Used for photography and videography by means of afocal coupling, the night vision monocular is very versatile. It enables the surveillance specialist to work from short- to ultra-long-range distances and it permits creating exceptionally fast optical systems for dark-night photography and videography while remaining passive.[9]

9. Night vision devices are passive–they emit no visible light or near infrared (IR) frequencies. Somebody using a night vision device for countersurveillance cannot detect another night vision device. Conversely, an infrared (IR) illuminator once activated is detectable by anybody using a night vision device for countersurveillance. Hence, activating an IR illuminator takes one from the passive to the active mode.

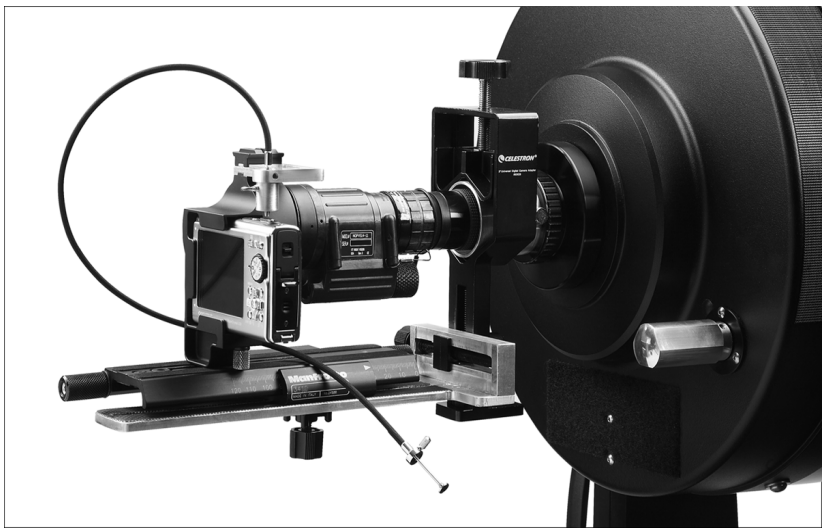

Figure 5-32. Monocam night vision camera system with the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device mounted to the 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). This configuration permits ultra-long-range afocal night vision photography. The modified Celestron 93626 Universal Digital Camera Adapter with the Manfrotto Micrometric Positioning Sliding Plate (focusing rail) properly aligns the objective lens of the night vision device with the telescope eyepiece. The robust author-invented eyepiece holder (visual back) supporting the camera assembly eliminates the need for the eyepiece itself to support the weight of the apparatus. Commonly, only 4–5 minute threads secure the eyepiece barrel to the portion of the eyepiece that extends into the visual back; do not trust it to support a camera and NVD. The night vision optical system shown here features an effective focal length and f-ratio of 1905mm f/6.25, shorter and faster than the 3048mm f/10 telescope. The 40mm telescope eyepiece being longer than the 25mm objective lens of the image intensifier night vision device (estimated focal length) reduces magnification and increases f-ratio. Together they act as a focal-reducer. The 5.6x focal length conversion factor of this Olympus camera results in an effective focal length, in this instance, of 10,668mm relative to angle-of-view (not magnification). Circumstances such as scene breadth and camera-to-subject distance determine when reduced angle-of-view is acceptable. This Olympus pocket camera accepts no electronic remote release so in-house fabrication of a mechanical cable release adapter is necessary. The telescope eyepiece provides an inverted image, an image that is upside-down and reversed left to right. Some photographers find an inverted image troublesome, while others adapt to it quickly. *Note:* A 56mm telescope eyepiece would result in an effective focal length and f-ratio of 1361mm f/4.46. Using a 56mm telescope eyepiece and f/6.3 focal-reducer together would result in an effective focal length and f-ratio of 857mm f/2.8, although the smaller aperture of the camera lens would prevail. The effective f-ratio of the entire optical system can be no faster than the smallest f-ratio, in this case the smaller f-ratio being the camera lens. Using a DSLR camera with a 50mm f/1.4 lens, this night vision device, this telescope, a 56mm telescope eyepiece and f/6.3 focal-reducer would result in an 857mm f/2.8 optical system (refer ahead to Figure 5-37 to view the optical configuration without the focal-reducer; the telescope eyepiece in that illustration is also a shorter focal length).

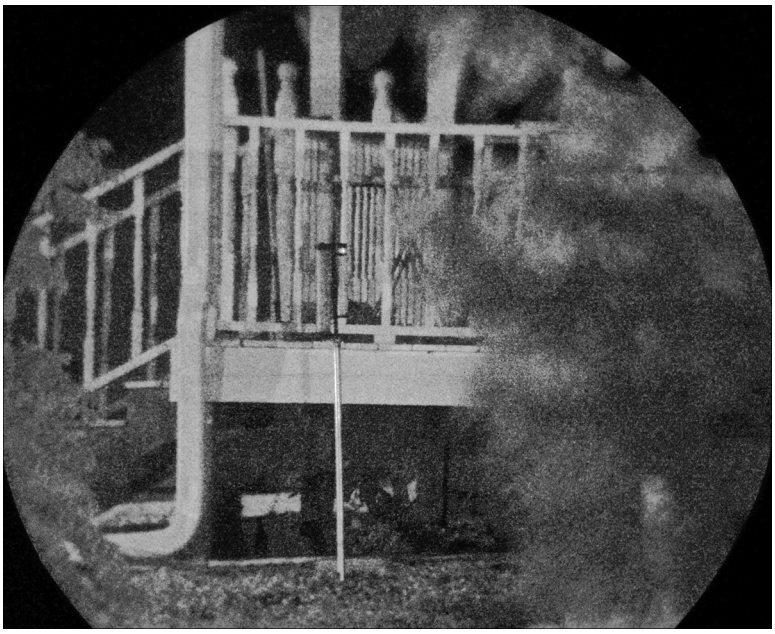

Figure 5-33. By means of afocal coupling, the surveillance specialist recorded this image from 274 meters (300 yards) using the Monocam night vision camera system with a small Schmidt-Cassegrain telescope. The optical configuration was the same as shown in the previous illustration, although the telescope was smaller. *Telescope:* 1500mm f/10 Celestron C6 Schmidt-Cassegrain telescope (SCT) with a 25mm telescope eyepiece. *Night vision device:* NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular. *Camera:* Olympus Stylus 1030 SW digital pocket camera. *Illumination:* 81 percent moon. *ISO:* 100. *Shutter speed:* 1/2 second. *Effective focal length and f-ratio of the optical system:* 1500mm f/10. No change in magnification and f-ratio occurred because the telescope eyepiece and the objective lens of the night vision device featured the same focal length, 25mm (focal length of the NVD objective lens estimated). *Magnification:* 30x. The 5.6x focal length conversion factor of this Olympus camera results in an effective focal length of 8400mm relative to angle-of-view (not magnification).

The NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device and its predecessor, the NQPVS-14, feature manual variable gain control. Minimum to maximum manual variable gain represents a range of approximately seven stops. That range of gain control provides considerable latitude when adjusting gain and camera ISO to find the ideal relationship between the two according to diverse nighttime lighting conditions. Using neutral density filters in conjunction with manual variable gain enhances versatility relative to illumination management. Refer back to the information addressing the use of neutral density filters under the earlier subheading *Neutral Density Filters for Long-Range SCT-Based AstroScope Photography.*

Pros and Cons

- ***Pros:***
  - The night vision monocular is small, lightweight, comparatively inexpensive, and versatile. It performs well for direct viewing and for photography.
  - For photography, the night vision monocular is very versatile. Using proper technique, it is suitable for short- to ultra-long-range night vision photography and videography. By means of afocal coupling, the night vision monocular permits doing the following:
    - Configure exceptionally high-magnification optical systems for extreme distance photography and videography.
    - Reduce magnification when the focal length of the host lens is too great for the camera-to-subject distance.
    - Configure exceptionally fast optical systems for night vision photography and videography under exceptionally low-light conditions. For example, by means of afocal coupling, the surveillance specialist can make a 3048mm f/10 Meade Schmidt-Cassegrain telescope an 853mm f/2.8 optical system.
  - Availability–ubiquitous. The third-generation (Gen 3) NEPVS-14 series image intensifier night vision device is ITAR controlled. Hence, only NATO and a few other select countries have access to this product. Nevertheless, surveillance specialists in virtually all countries have access to some brand of monocular night vision device. The photographic principles and application methods presented in this chapter apply to virtually all image intensifier monocular night vision devices regardless of manufacturer and regardless of generation (e.g., Gen 2 or Gen 3). Never use Gen 1 for photography.
  - High quality, rugged, waterproof.
  - Good warranty period.
  - Requires only one battery, which is readily available on the commercial market.
  - Features manual variable gain control.
  - Adaptable to the BushHawk Shoulder Mount.
  - Adaptable to the Roc Stoc Tactical Shoulder Stock Rail Interface system manufactured by Morovision Night Vision, Inc.
  - Adaptable to Kenyon gyrostabilizers.
- ***Cons:***
  - The ITT NEPVS-14 series image intensifier NVD monocular, as stated, is not available to surveillance specialists in all countries although monocular night vision devices made by other manufacturers are universally available.

- Not optimized for photography. Manufacturers optimize the image intensifier night vision monocular for direct viewing, not photography.
- Not particularly user-friendly when used for photography.
  - For photography, advanced hybrid methods require a high level of technical expertise.
  - Long-range and ultra-long-range photography is possible only by means of afocal coupling.
  - Efficient camera adapting requires using an in-house fabricated mounting platform so that the camera and NVD is an integrated unit.
  - Advanced hybrid applications for long-range and ultra-long-range photography require custom fabrication of support systems in addition to the mounting platform mentioned above.
  - Afocal coupling results in an inverted image, an upside-down image reversed left to right. The inverted image diminishes ease of operation.
- ***Best Uses:*** The image intensifier monocular night vision device (NVD) is suitable for virtually all genus of night vision photography from short- to ultra-long-range imaging, single image or HD video. By means of afocal coupling, using suitable accessories and proper technique, it is highly versatile and results in good image quality, although not comparable to AstroScope image quality. Afocal coupling permits increasing and decreasing magnification and f-ratio. Hence, it makes short- to ultra-long-range night vision photography possible and it permits configuring exceptionally fast optical systems for dark-night photography. Afocal coupling for long-range photographic imaging is most appropriate for static surveillance, situations wherein the surveillance specialist sets up at a distant vantage point to photograph activity at a specific location.

Camera Adapting the Monocular Night Vision Device

The camera adaptable NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device and its predecessor, the NQPVS-14, manufactured by ITT Night Vision and marketed in the United States by Morovision Night Vision, Inc. and in Canada by Current Corporation, Law Enforcement Division supports this discussion (see Figures 5-34 and 5-35). Nevertheless, previously stated, the photographic principles and methods presented in this section apply to virtually all monocular night vision devices.

Figure 5-34. The camera adaptable NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device is ideal for direct viewing. It is also suitable for photography and videography by means of afocal coupling. This night vision device features Automatic Brightness Control (automatic intensifier tube gain) and manual variable gain control. Manual variable gain control is useful when photographing in an urban environment featuring varying levels of artificial illumination, which often requires manually adjusting gain level. *Resolution:* 57 lp/mm minimum, 64 lp/mm typical. *Brightness gain:* Adjustable from 25 to more than 3000 fL/fL. *Magnification:* 1x (accepts 3x and 5x extension magnification lenses). *Field-of-view:* 40 degrees. *Objective lens:* 25mm f/1.2 (focal length estimated). *Dimensions (Length, width, height):* 114.3 x 50.8 x 57.15 millimeters (4.5 x 2 x 2.25 inches).

Camera adapting a monocular night vision device (NVD) without using a mounting platform such as the author-invented platform, illustrated above, results in a loose assembly that is difficult to use. Without the platform to contain the camera and NVD as an integrated unit, the NVD rotates on the camera lens, which makes focusing the NVD objective lens difficult. Looseness of the camera/NVD assembly also prevents efficient afocal coupling with high-magnification telephoto lenses and telescopes.

The mounting platform is not commercially available, but it is easy to fabricate. When on the platform, the camera must be free to slide forward and backward when focusing the lens. *Before turning the camera on, be sure that it is free to slide forward and backward on the mounting platform and ensure that auto-focus is off!* During use, focus the lens manually. Before camera adapting the night vision device, set the diopter adjustment to your eye by focusing on a star. Further adjustment of the diopter is sometimes necessary during afocal photography.

Figure 5-35. Mounting the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device to a digital single-lens reflex (DSLR) camera requires the *Camera Adapter Assembly* and appropriate step up/down adapter rings. To acquire step up/down adapter rings go to www.camerafilters.com. The Camera Adapter Assembly attaches the night vision device to the camera by screwing it to the filter threads of the camera lens. Illustrated here is the Canon EOS 5D digital single-lens reflex camera with the Canon EF 50mm f/1.4 USM lens. The Camera Adapter Assembly works with digital single-lens reflex cameras, as shown here, and it works with camcorders in the same manner (refer ahead to Figure 5-41). The mounting platform is necessary so that the camera and night vision device function as an integrated unit. On the mounting platform, the camera must be free to slide forward and backward during focusing. Before turning the camera on, be sure auto-focus is off.

A 1/4-20 female threaded hole in the center of the platform accepts a handle for handheld use, accepts a gyrostabilizer, and it permits mounting the assembly to a tripod or other suitable support. If desired, add also a 3/8-16 threaded hole, the screw size of some tripod heads.

This night vision device accepts the Mil-Spec (military specifications) f/1.5 3x and f/2.4 5x extension magnification lenses.

Ultra-Long-Range Afocal Night Vision Photography

The ability to photograph from extreme distances increases vantage point options and it minimizes the likelihood of detection by the subject. Safety and preserving the cover of plainclothes operatives is important.

A Team Bloginity article titled *How To Use Long Camera Lenses* (2010, March 9, n.p.) reports that, "Few techniques in photography require more expertise and skill than the successful use of a long tele or zoom lens." Requisite expertise is greater yet when using a night vision device with high-magnification optics for ultra-long-range night vision photography and videography. Night vision photography from extreme distances commonly requires using focal lengths of 3,000-millimeters to over 5,000-millimeters (refer back to Figure 5-26 and refer ahead to Figure 5-39, those images recorded using an effective focal length of 3290 millimeters and 5,080 millimeters respectively).

As stated, using an image intensifier monocular night vision device (NVD) for extreme distance photography and videography requires afocal coupling (see Figure 5-36 and refer ahead to Figures 5-37 and 5-38). During afocal night-vision photography, the telescope eyepiece projects a virtual image that becomes the NVDs real image. The eyepiece, whether on a telephoto lens or on a telescope, projects an image into the objective lens of the NVD. The eyepiece of the NVD provides a view of the image on the green phosphor screen of the NVD. Through the eyepiece of the NVD, the camera photographs the image on the phosphor screen.

During afocal night-vision photography, a telescope eyepiece shorter than the objective lens of the night vision device (NVD) increases magnification and reduces effective f-ratio. Conversely, a telescope eyepiece longer than the objective lens of the NVD acts as a focal-reducer–it reduces magnification and increases effective f-ratio.

Astro-photographers use afocal coupling to take pictures through a telescope. When photographing through the eyepiece of a telescope they call it afocal photography. The afocal photography method is largely the same whether photographing during daylight hours without a night vision device or photographing at night using a night vision device. Moreover, the method is the same whether using a single image camera or a camcorder. The difference is that afocal photography during daylight hours is conventional afocal photography–the camera photographs through a telescope eyepiece. Afocal photography using an image intensifier night vision device (NVD) is actually a double afocal configuration. That is, the camera photographs through the eyepiece of the NVD while the objective lens of the NVD views through a telescope eyepiece. Previously stated, the telescope eyepiece can be on a telescope or on a telephoto camera lens.

The concept of afocal photography emerged following the introduction of the 35mm format camera to the commercial market in 1925. Because the early 35mm cameras did not feature interchangeable lenses, photographers needing a telephoto capability photographed through the eyepiece of a tele-

Figure 5-36. Afocal photography is simply taking pictures through a telescope eyepiece. The Canon EF 600mm f/4L IS USM super telephoto lens sports a 2x tele-converter and a 14.5mm telescope eyepiece. The Canon EOS 5D digital single-lens reflex full-frame camera sports a 50mm f/1.4 lens. The night vision device features a 25mm f/1.2 objective lens (estimated focal length). The effective focal length and f-ratio of this electro-optical configuration is 2069mm f/14 (specifically 2068.8mm f/13.79). The effective focal length and f-ratio calculations did not include the focal length of the camera's normal lens or the 26mm focal length of the NVD eyepiece. That is because they do not affect magnification or f-ratio–the camera simply photographs the image on the NVDs green phosphor screen, accomplishing that by photographing through the NVD eyepiece. Mounting a telescope eyepiece to a telephoto camera lens, as illustrated here, requires a custom-made eyepiece adapter.[10] Two Manfrotto Micrometric Positioning Sliding Plates (focusing rails) permit fine adjustment of the night vision device left/right and closer/farther from the telescope eyepiece. The SNAP (Siljander-Neipert Afocal Platform) provides fine up/down adjustment of the camera. Supporting the apparatus is the Majestic #1001 3/8″ Screw Mount Gearhead with 6x7-inch Camera Platform.

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10. Making an eyepiece adapter for a telephoto camera lens is easy. Salvage the eyepiece receptacle from a telescope *mirror diagonal* and mount it to a camera-lens dust cap (rear lens cap). Cut out the threaded portion of the mirror diagonal to make a retaining nut to secure the eyepiece receptacle to the dust cap. Shortening the eyepiece receptacle to accommodate the back focus of the lens may be necessary, as was the case with the eyepiece adapter illustrated above. The authors used a lath to shorten the receptacle. The PVC ring (white) serves only to provide wall thickness for setscrew threads, the original setscrew hole being lost during the shortening process. Paint the PVC ring black; it is white here for visual separation to serve better for illustration purposes. Make the ring using aluminum if preferred.

scope, that being afocal photography. The 35mm fixed-lens camera performed reasonably well for that purpose.

Most image intensifier night vision devices (NVDs) feature a short focal length objective lens, the lens commonly providing 1.0x magnification and a 40-degree field-of-view. For clandestine photography, magnification greater than 1.0x is necessary. For short to moderate distances, the surveillance specialist can use the Mil-Spec (military specifications) f/1.5 3x or f/2.4 5x extension magnification lenses. For greater distances afocal coupling with a telephoto camera lens or telescope is necessary.

Long-range and ultra-long-range night vision photography by means of afocal coupling is effective but, as stated, it requires a high level of technical expertise. Indeed, more is required than simply arranging the various optical and electro-optical components in the correct order. Precise alignment and proper spacing of all components is necessary. When properly executed, afocal coupling is an effective and versatile method for ultra-long-range night vision photography and it permits creating very fast optical systems for dark-night photography (see Figures 5-37 to 5-40).

When using afocal coupling, the method for calculating the effective focal length and f-ratio of the optical system requires knowing the following:

- Focal length and f-ratio of the telephoto lens or telescope.
- Focal length of the telescope eyepiece.
- Focal length and f-ratio of the night vision device objective lens.

Some of the technical specifications of the PVS-14 series night vision monocular are ITAR[11] controlled and for that reason, they are undisclosed. Although the manufacturer discloses that this series NVD contains an 18-millimeter intensifier tube, f/1.2 objective lens, 1x magnification and a 40-degree field-of-view, the focal length of the objective lens remains undisclosed. That is unfortunate because computing the effective focal length and f-ratio of the optical system requires knowing the focal length of the NVD objective lens. Because other NVDs with the same specifications identified

11. The International Traffic in Arms Regulations (ITAR) is the body of United States government regulations controlling the export and import of defense articles and services identified on the United States Munitions List. Public domain information is outside the control of ITAR. The night vision devices and some related items featured in this chapter are ITAR controlled and therefore subject to export restrictions. They cannot leave the United States without approval by the U.S. Department of State. Among the products featured in this chapter that are subject to export control are all night vision devices, the Monocam Digital Camera Adapter Kit even without the night vision monocular it accommodates, the Mil-Spec (military specifications) 3x and 5x extension magnification lenses, and the infrared (IR) illuminators.

Figure 5-37. The modified Celestron 93626 Universal Digital Camera Adapter and Manfrotto Micrometric Positioning Sliding Plate (focusing rail) permit alignment of the night vision device with the telescope eyepiece. *Telescope:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). *Night vision device:* NEPVS-14 Night Enforcer Gen 3 PINNACLE night vision monocular. The robust author-invented eyepiece holder (visual back) supporting the camera adapter eliminates the need for the eyepiece itself to support the weight of the apparatus. This system as shown, with a 15mm telescope eyepiece, provides an effective focal length and f-ratio of 5078mm f/17 (specifically 5077.97mm f/16.66). When using this apparatus with a Schmidt-Cassegrain telescope (SCT), as illustrated here, place a sandbag or shot bag towards the front of the telescope tube to balance it, doing that to compensate for the weight of the camera and night vision device. Balancing the telescope is necessary to avoid overstressing the drive motor and gear system that articulates the vertical movement of the telescope. This afocal configuration works well with camcorders and still cameras with and without a night vision device. *Note:* When necessary, use a telescope eyepiece of greater focal length than the objective lens of the NVD to reduce magnification and increase f-ratio. For example, this configuration with a 56mm telescope eyepiece would result in an effective focal length and f-ratio of 1361mm f/4.46. Using an f/6.3 focal-reducer with the 56mm telescope eyepiece would result in an effective focal length and f-ratio of 857mm f/2.8.

above feature a 25-millimeter objective lens, the authors use that value when computing effective focal length and f-ratio during afocal photography using a PVS-14 series NVD. If the focal length of the PVS-14 objective lens is slightly more or less, computations are inaccurate, but inaccurate in a consistent manner.

Under the subheading *Computing Effective Focal Length and F-Ratio,* Chapter 4 explains how to compute effective focal length and f-ratio when doing afocal photography. The explanations provided in Chapter 4 apply to

Figure 5-38. Using two tripods for afocal night vision photography restricts camera and lens mobility, but it prevents transfer of vibration between the camera and telescope. Although not the same Schmidt-Cassegrain telescope (SCT), this is the optical configuration used to record the image in the next illustration. Two Manfrotto Micrometric Positioning Sliding Plates (focusing rails) permit fine adjustment of the night vision device left/right and closer/farther from the telescope eyepiece. Illustrated is the Canon EOS 30D digital single-lens reflex (DSLR) crop-sensor camera with the Canon EF 50mm f/1.4 USM lens. Mounted to the camera lens via the Camera Adapter Assembly is the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device (refer ahead to Figure 5-41 to view the Camera Adapter Assembly). The telescope featured here is the 2350mm f/10 Celestron C9.25″ SCT with a 25mm telescope eyepiece. Effective focal length and f-ratio is 2350mm f/10. The focal length of the telescope eyepiece being the same as the focal length of the NVD objective lens results in no change to focal length and f-ratio. Some mounts made for astronomical telescopes permit directing the telescope towards the sky but do not permit horizontal and downward positioning of the telescope with that being true of the German equatorial mount featured here. Such mounts are unsuited for terrestrial photography without a custom-made wedge to reposition the lens as shown, or modifying the mount so it permits pointing the telescope downwards. Discussion in Chapter 4 addressed this issue. The wedge features a dovetail mounting plate on the underside that the equatorial mount accepts. The lens, in turn, attaches to the top of the wedge just as it would attach to the equatorial mount. *Note:* With the telescope supported by the wedge, horizontal panning causes the front of the telescope tube to tip downward. Therefore, precise initial positioning of the telescope relative to the subject is important so that minimal framing adjustment of the telescope is thereafter required. *Note:* Position the telescope assembly on the tripod so that one tripod leg is forward. Then, lifting the two rear legs permits easily rotating the entire assembly to change the area of view.

Figure 5-39. The surveillance specialist recorded this ultra-long-range 102x magnification night vision photograph from 1.03 kilometer (0.64 mile). *Atmospheric condition:* Poor—intermittently rainy night (refer back to Figure 5-26, that image recorded with better nighttime illumination from only 18 percent less distance). *Method:* Afocal coupling (afocal photography). *Telescope:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope (SCT). *Telescope eyepiece:* 15mm. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Camera lens:* Canon EF 50mm f/1.4 USM. *Night vision device:* NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device. *NVD Objective lens:* 25 mm f/1.2 (estimated focal length). *ISO:* 100. *Shutter speed:* 1/13 second. *Effective Focal Length and f-ratio of the optical configuration:* 5078mm f/17. Calculations based on Projection Magnification. This is a photographic application begging further experimentation because potential methods exist to enhance image quality. This image features the telephoto lens compression effect resulting from the long perspective, the extreme camera-to-subject distance. The two girls are approximately 27.43 meters (30 yards) closer to the camera than the male subject is. In the male subject's right hand is a lit cigarette, that being evident even from this long distance. Do not smoke during tactical operations! The angle-of-view of the optical system used to record this image is approximately 0.19 degrees. Quickly locating distant subjects during extreme-distance night vision photography requires using a night vision weapon sight as a finder scope (refer back to Figure 5-17).

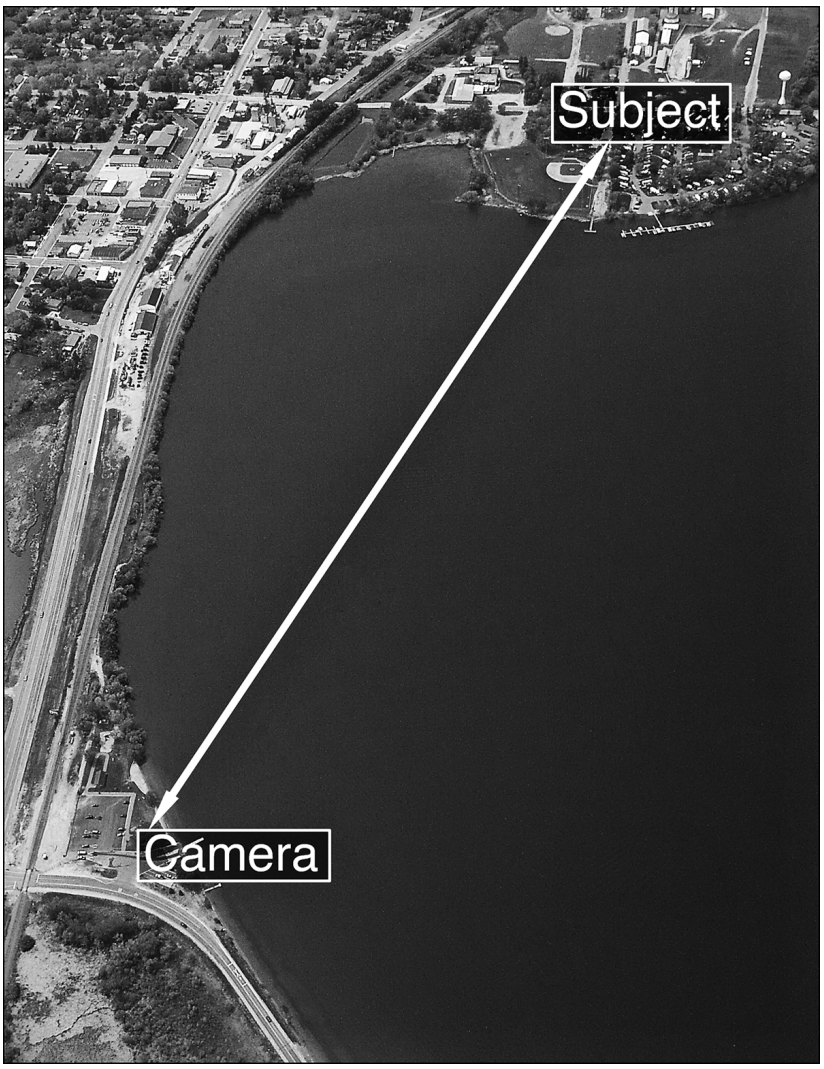

Figure 5-40. This aerial view shows the camera and subject locations of the previous illustration. This view illustrates the considerable distances from which night vision photography is possible, the distances from which the surveillance specialist can record detail such as recognizable images of human subjects and legible vehicle number plates. Relative to night vision photography and videography, a camera-to-subject distance considerably greater than this is possible, perhaps double this distance. That is, for the recording of recognizable images of people and legible vehicle number plates.

night-vision afocal photography except that computations use the focal length of the NVD objective lens rather than the lens on the camera or camcorder.

Night Vision Monocular and Camcorders

Using the HD video capture feature of a digital single-lens reflex (DSLR) camera enables the surveillance specialist to do higher quality long-range night vision videography than is possible when using an HD camcorder. For example, at the time of this writing, the Canon EOS 5D Mark II full-frame DSLR camera offers true HD video capture at 1920 x 1080 pixels at 30 frames per second. The newly introduced and considerably less expensive EOS Rebel T3i crop-sensor DSLR camera records HD video at 1920 x 1080 pixels at 30 fps with manual exposure control. The Rebel also records video at 24 and 25 fps. Similar to the Canon EOS Rebel T3i crop-sensor DSLR camera is the Nikon D5100 DSLR crop-sensor camera.

During night vision videography, achieving an adequate shutter speed is sometimes a challenge. The surveillance specialist should record moving video images at 30 frames per second but doing that requires using a shutter speed greater than 1/30 of a second. In many instances, achieving a suitably fast shutter speed requires increasing ISO and increasing the night vision device manual variable gain, both of which degrade image quality. Another option during afocal night vision photography is to configure a fast optical system by using a telescope eyepiece of greater focal length than the focal length of the objective lens of the night vision device. Unfortunately, in some instances, using an infrared (IR) illuminator is necessary although that takes one from the passive to the active mode and consequently detectable by a subject using an image intensifier night vision device for countersurveillance. When necessary, record moving video images at fewer that 30 frames per second.

A digital single-lens reflex camera in video capture mode provides the means to record higher quality night vision video than is possible when using a conventional camcorder. This is especially true relative to the largely automated consumer grade camcorders. Camcorders feature a small image sensor and most camcorders in the consumer category lack full manual control of essential functions (e.g., ISO, shutter speed, aperture, and focus). Nevertheless, in spite of their shortcomings camcorders remain useful for night vision videography because they are small, lightweight, inexpensive, and they permit recording uninterrupted for extended periods.

The NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device coupled with a camcorder permits recording moving video images at night. Mounting a Mil-Spec (military specifications) f/1.5 3x or f/2.4 5x extension magnification lens on the night vision device extends camera-to-subject distance (see Figures 5-41 and 5-42). Afocal coupling permits extreme-distance night vision videography and it permits configuring fast optical systems (see Figure 5-43 and refer to Figures 4-41 and 4-42 in Chapter 4).

Figure 5-41. The PVS-14 Camera Adapter Assembly permits adapting the night vision device (NVD) to the camcorder by screwing it to the filter threads. This is the same Camera Adapter Assembly used to mount this NVD to a digital single-lens reflex camera (refer back to Figure 5-35). In many instances, using step up/down adapter rings is necessary.

Consumer-grade camcorders provide fair results, but prosumer- and professional-grade camcorders permit manual control of essential functions such as ISO and shutter speed, which makes better results possible. High ISO degrades image quality, the extent of degradation depending on the level of ambient illumination. To record superior night vision videography, use the AstroScope with a digital single-lens reflex (DSLR) camera featuring full HD movie mode with manual exposure control. In addition to full control of

Figure 5-42. Configured for moderate-range night vision videography, the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device (NVD) sports the Mil-Spec (military specifications) f/2.4 5x extension magnification lens. Like the Mil-Spec 3x f/1.5 extension magnification lens, this lens optically is a Galilean afocal telescope (refer to Figure 3-20 in Chapter 3). The author-invented platform supporting the camcorder adapted NVD greatly simplifies use. Without the platform to contain the camcorder and NVD as an integrated unit, the NVD rotates on the camera lens, which makes focusing the NVD objective lens difficult. The same situation occurs when using the NVD with a digital single lens reflex camera. The platform features a 1/4-20 threaded hole that accepts the handle shown here, it accepts a gyrostabilizer, it permits mounting the assembly to a tripod or other support system such as the BushHawk shoulder mount or the Morovision Roc Stoc Tactical Shoulder Stock Rail Interface system, or the SNAP shown in the next illustration. If desired, when constructing the platform, add also a 3/8-16 threaded hole, the screw size of some tripod heads.

Figure 5-43. The author-invented SNAP (Siljander-Neipert Afocal Platform) supports the Canon VIXIA HV30 high-definition (HD) consumer-grade camcorder, NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device (NVD), and Canon EF 600mm f/4L IS USM super telephoto lens with a 40mm telescope eyepiece. The focal length of the host lens (600mm f/4), telescope eyepiece (40mm), and the NVD objective lens (25mm) determine the effective focal length and f-ratio of the optical system, 375mm f/2.5 in this instance. The focal length of the telescope eyepiece (40mm) being greater than the focal length of the NVD objective lens (25mm) acts as a focal-reducer. The result is decreased magnification and increased effective f-ratio (increased lens speed). This is a fast optical system! It is 1/3 stop faster than the Canon and Nikon 400mm f/2.8 telephoto lenses with magnification being only slightly less. During night vision photography and videography, a 1/3 stop advantage is significant. Because the telescope eyepiece provides an inverted image, an image that is upside-down and reversed left to right, recording a correct image requires using the author-invented inversion bracket to position the camcorder in the upside-down position. Later, when viewing the video, the image is upright and correct left to right. This method eliminates the need for postvideography editing to upright the images. This camcorder features a 7.15x focal length conversion factor, which results in the optical configuration shown here featuring an effective focal length of 2,681mm relative to angle-of-view (not relative to magnification). The photo mode feature of this camcorder permits selecting single-frame (freeze-frame) images while recording moving video images. Unfortunately, recording freeze-frame images causes a brief interruption of video filming. A brief interruption of video filming can result in failure to record an important so-called decisive moment.

camera functions, a DSLR camera provides the benefit of a large image sensor. Even the image sensor in a crop-sensor DSLR camera is large by camcorder standards. The large image sensor permits using higher magnification lenses without unduly restricting field-of-view.

INFRARED ILLUMINATORS

Supplemental infrared (IR) illumination permits night vision photography from any extreme distance that magnification and the atmosphere permits. It is the illuminator-to-subject distance, not camera-to-subject distance that determines exposure. The detriment to using an IR illuminator is that it takes one from the passive to the active mode. Once activating an IR illuminator, anybody using a night vision device for countersurveillance can detect it.

Professionally Manufactured Infrared Illuminators

Image intensifier night vision devices (NVDs) operate on the principle of light intensification (light amplification) and for that reason, they do not work in complete darkness. An overcast night with no moonlight or starlight, and no manmade lights near the subject can render a night vision device ineffective. In such instances, using one or more infrared (IR) illuminators to illuminate the subject area is necessary. This is true whether using an NVD for direct viewing or for photography (see Figure 5-44).

Sofradir EC, Inc. sells the ALS-40 Infrared Illuminator. This long-range laser diode-based 12-volt DC illuminator is eye-safe; it features a Class 1 eye safety rating (IEC-60825-1) even in the long-range (narrow angle) mode. At narrow angle (10-degrees) and wavelength 810 nm (nanometer), this illuminator features a maximum range of 0.80 kilometer (0.497 mile). The 810 nm wavelength emission results in a detectable slight red glow. The optional 950 nm wavelength emission reduces maximum range but renders the illuminator undetectable using unaided vision. Unfortunately, somebody using a night vision device for countersurveillance will detect any IR illuminator from any distance.

In the field, one can power this high-demand IR illuminator using a heavy-duty 12-volt DC battery pack or, because an AC power supply is available as an accessory, a well-muffled portable generator will power it for an extended period. This illuminator measures approximately (HxWxD) 41 x 25 x 30 centimeters (16 x 10 x 12 inches) and weighs 8.16 kilograms (18 pounds). In the field, depending, of course, upon circumstances, consider mounting the illuminator on a heavy-duty tripod or a tree-mount support

Figure 5-44. During night vision photography, infrared (IR) illuminators are necessary when the level of ambient illumination is inadequate. *Left image:* The adjustable beam IR illuminator on the left features a maximum range of 182.88 meters (200 yards). The non-adjustable beam 860-nanometer IR illuminator on the right features a maximum range of 914.4 meters (1,000 yards). Both IR illuminators produce a slight red glow. The PVS-14 series night vision devices are included for size reference. *Right image:* The eye safe ALS-40™ Infrared Illuminator at narrow angle (10-degrees) and wavelength 810 nm features a maximum range of 0.80 kilometer (0.497 mile). Right image courtesy of Sofradir EC, Inc. *Note:* In the United States, these IR illuminators require State Department License for export.

featuring a heavy-duty geared head (refer to Figure 3-19 in Chapter 3 to view the tree-mount support).

Surveillance specialists doing long-range night vision photography should contact the manufacturer for product details as they pertain to specific field needs. The 10-degree beam spread of this illuminator is not too narrow for extreme-distance night vision photography. That is because the angle-of-view of optical systems used for long-range night vision photography is usually less than one degree.

When using an IR illuminator to illuminate the subject, the person positioning the IR illuminator uses an image intensifier night vision device (NVD) to ensure proper coverage of the subject area. If the NVD features manual variable gain control, use as little gain as necessary to see for proper positioning of the IR illuminator. Articulate the NVD to keep the scene slowly moving within the field-of-view to prevent creating a burn spot on the phosphor screen of the intensifier tube and to prevent reducing the tube's service life.

Illuminating the subject using an IR illuminator provides six benefits. The six benefits are:

- Enhanced illumination minimizes NVD automatic gain, which minimizes scintillation, which in turn improves image quality. "Scintillation is electronic noise, a faint, random, sparkling effect throughout the image area" (Morovision Night Vision, Inc., 2010, n.p., *Scintillation*).
- Enhanced illumination permits using a lower level of manual variable gain. Elevated manual variable gain creates slightly more electronic noise than elevated ISO does.
- Enhanced illumination permits using a lower ISO. Low ISO provides better image quality than high ISO does.
- Enhanced illumination permits using a faster shutter speed to freeze subject movement.
- Enhanced illumination by means of supplemental infrared (IR) illumination permits night vision photography from any extreme distance that magnification and the atmosphere permits. It is the illuminator-to-subject distance, not the camera-to-subject distance that affects exposure.
- Enhanced illumination provides better visual separation between the subject and the background (see Figures 5-45 and 5-46).

Figure 5-45. Subject photographed from 274.32 meters (300 yards) with and without the use of an infrared (IR) illuminator. *Upper image:* The moon and stars and a security light some distance away illuminated the subject. No infrared (IR) illuminator used. Shutter speed 1/13 second. *Lower image:* An infrared (IR) illuminator illuminates the subject area from a distance of approximately 69 meters (75 yards), the illuminator located in front of and about 45 degrees to the side of the subject (refer to the next illustration). The shutter speed of 1/20 second represents an increase of approximately 2/3 stops. Directing the IR illuminator from an angle prevented illuminating the atmosphere between the camera and subject and it prevented glare from the vehicle number plate. On the back of the vehicle are shadows caused by foliage located between the IR illuminator and subject vehicle. That was deliberate to illustrate the importance of locating IR illuminators with care. When positioning IR illuminators use a night vision device to ensure proper and unobstructed coverage of the subject area. Observe in the lower image the better separation of the subject from the background, especially his upper torso and head. The subject is wearing blue denim jeans and a dark colored shirt yet the jeans became light and the shirt almost white when illuminated by an IR illuminator. The clothing material is more reflective of near infrared frequencies than it is of visible light. *Optical system:* 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope and f/6.3 focal-reducer. The focal-reducer increased effective f-ratio, reduced magnification, and increased field-of-view. Without the focal-reducer, the magnification of this telescope is too great for this short distance. *Effective focal length and f-ratio:* 1920mm f/6.3. *Method:* Prime-focus (direct coupling). *Night vision device:* A nonstandard AstroScope Night Vision Module configured for use with a Questar telescope.[12] *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *ISO:* 800. *Exposure bias:* -0.3 step. This illustrates the importance of never underexposing during night vision photography because it causes avoidable image degradation.

12. Questar Corporation manufactures exceptional quality Maksutov-Cassegrain telescopes. Nevertheless, for several reasons, the authors choose not to use any brand Maksutov-Cassegrain telescopes (Mak lenses) for manual clandestine photography. *First,* they are slower than Schmidt-Cassegrain telescopes (SCTs) by approximately 2/3 to 1 1/3 stops, depending on manufacturer and Mak lens model. Celestron, manufacturer of high quality Schmidt-Cassegrain telescopes, under the title *What is the focal ratio? How is it related to the f-stop?,* explains that "Fast focal ratios of telescopes are f/3.5 to f/6, medium are f/7 to f/11, and slow are f/12 and longer" (Celestron, 2008, n.p.). During low illumination available light photography and during night vision photography, the surveillance specialist usually needs maximum f-ratio (maximum lens speed). Naturally, selecting a medium-speed telescope over a slow-speed telescope is sensible. *Second,* the slow f-ratio of Mak lenses results in field-of-view being narrower in comparison to Schmidt-Cassegrain telescopes of comparable aperture. For clandestine applications, field-of-view is too important to sacrifice. *Third,* the thickness of the front corrector plate of a Mak lens delays achieving thermal equilibrium. Delayed thermal equilibrium is unacceptable for clandestine applications. Often photographing must begin soon after setup with little time available to achieve thermal equilibrium. *Fourth,* maximum focal length of Mak lenses is limited. The design of Schmidt-Cassegrain telescopes permits making much higher magnification products. Jerry Lodriguss, in his discourse titled *Telescopes for Digital Astrophotography* (2010, n.p.), validates the authors' concerns regarding the slow speed and delayed thermal equilibrium of Mak lenses. He reports that, "A Maksutov can provide excellent optical performance, but the f/ratios are usually too slow for astrophotography of anything except the Sun, Moon, planets and bright double stars, and can suffer from the thermal problems because it takes a long time for the mass of the corrector to reach thermal equilibrium with the ambient atmospheric temperature." Confirming the excessive time required for a Mak lens to reach thermal equilibrium, Randy Muller (1999, June 8, n.p.) states, "I have a 9″ Intes MK-91 Maksutov-Cassegrain scope. It takes a very, very long time to come into thermal equilibrium." For the above reasons, the authors feel that Mak lenses are a poor choice for clandestine applications.

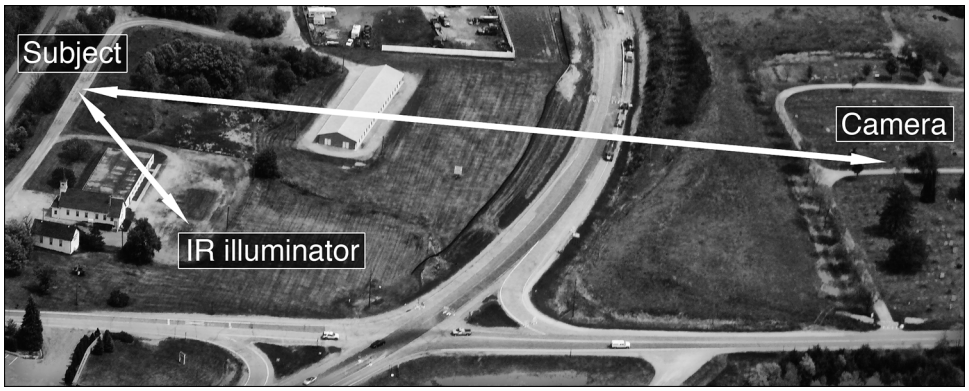

Figure 5-46. This aerial view identifies the location of the subject, camera, and infrared (IR) illuminator in the previous illustration. Never illuminate the subject from the camera location or from along the camera line-of-sight, text soon discussing the reasons for this. (Short- to intermediate-range photography permits using an IR illuminator from the camera location). *Aircraft altitude:* Approximately 305 meters (1,000 feet). *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 24-105mm f/4L IS USM zoom lens at 65mm. *ISO:* 1,000. *Aperture:* f/9. *Shutter speed:* 1/500 second. *Aircraft:* Cessna Skyhawk 172.

One or more infrared (IR) illuminators can be located at multiple sites, activated, and then left unattended (see Figure 5-47). Alternatively, team members can attend some or all of the IR illuminators, activating and deactivating them as instructed via radio by the surveillance specialist or observer. Remote activation and deactivation of IR illuminators is also an option to consider.

Previously stated, illuminator-to-subject distance, not camera-to-subject distance, determines exposure. During standard flash photography, photographers calculate exposure based on flash-to-subject distance, not camera-to-subject distance. In the same respect, during night vision photography, it is the distance between the IR illuminator and the subject that determines proper exposure, not the distance between the camera and the subject.

Think of an infrared (IR) illuminator as a flashlight (torch). Illuminator-to-subject distance determines how brightly the subject is illuminated. When the IR illuminator is close to the subject, the subject is brightly illuminated. Locating the IR illuminator far from the subject reduces illumination intensity. Regarding this issue, Dennis P. Curtain (2007, n.p.) explains that, "The light from a flash falls off with distance. When you double the distance, you get one quarter as much light. This relationship is called the inverse square law." Understanding this is important because the same physics apply to an IR illuminator.

Figure 5-47. The Wimberley Plamp supports a small handheld infrared (IR) illuminator for activation after darkness sets in.

Doubling the distance between the IR illuminator and the subject reduces the intensity of illumination to one-forth of what it was, as Dennis Curtain explained. Double the new distance and the intensity of illumination is only one-sixteenth of what it originally was. That occurs because the illumination provided by the IR illuminator covers more area (see Figure 5-48). Conversely, reducing the IR illuminator-to-subject distance by half increases the level of subject illumination by four times. That occurs because the illumination provided by the IR illuminator covers only one-fourth the area. This law of physics applies whether using an IR illuminator, conventional camera flash, or a flashlight (torch).

When surveillance reveals that a subject's countersurveillance efforts by means of a night vision device are sporadic, using an infrared (IR) illuminator for photography may be feasible. In such instances, however, the observer must be highly alert for indications that the subject is about to use a night

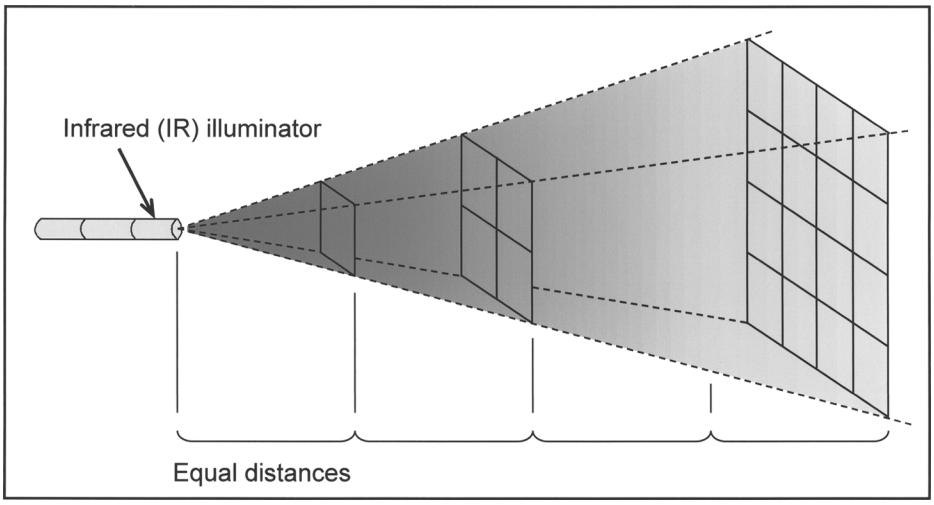

Figure 5-48. Because the types of infrared (IR) illuminators used for manual clandestine photography emit a diverging beam, the distance between the IR illuminator and the subject determines the intensity of subject illumination. Doubling the distance between the IR illuminator and the subject reduces the intensity of illumination to one-fourth of what it was. Reducing distance by half increases the intensity of subject illumination by four times. Because the IR illuminator beam diverges and becomes weaker with distance, and because of atmospheric attenuation, an IR illuminator that is not eye safe at the source is eye safe beyond a certain distance. Beyond a certain distance, a noneye-safe IR illuminator will not injure the eyes of a subject. Know what that distance is when using an IR illuminator that is not eye safe. *Important:* Some lasers emit a nondiverging beam and therefore they would not be eye safe at any distance were it not for atmospheric attenuation. These illuminators are atypical.

vision device for purposes of countersurveillance. The observer must have the means to advise IR illuminator operators to deactivate all illuminators. *Note:* People are creatures of habit and they tend to conform to predictable routines. Additionally, many people become complacent when nothing eventful occurs. Exploit the idiosyncrasies of human nature during investigations, intelligence gathering, physical surveillance, and during clandestine photography operations.

When using an infrared (IR) illuminator for long-range night vision photography, do not position the illuminator at the camera location or anywhere along the line-of-sight between the camera and subject. Additionally, when circumstances permit, place IR illuminators closer to the subject than the photography team is located. For example, if the photography team is 0.80 kilometer (0.50 mile) from the subject, place an IR illuminator perhaps 0.60 kilometer (0.375 mile) from the subject or even as close as 0.40 kilometer (0.25 mile) from the subject, sometimes even closer.

There are reasons to locate an IR illuminator remote from the camera and far from the line-of-sight between the camera and subject, and closer to the subject. The reasons, some already addressed, include:

- Avoid obscuring the subject by illuminating moisture and impurities in the atmosphere between the subject and camera. Accomplish this by never illuminating the subject from the camera location or from a location along the line-of-sight between the camera and subject.
- Safety of the photography team and security of the operation increases as the distance between the camera and IR illuminator increases. Detection of an IR illuminator by a subject must not suggest the existence of a photography team or reveal its location. A subject detecting an IR illuminator is unlikely to suspect the existence of a photography team located elsewhere and at a much greater distance. In this respect, an IR illuminator serves as a decoy should discovery occur (see Figure 5-49).

Eye safety is important when using infrared (IR) illuminators. IR illuminators receive an eye safety classification and although there are several classification categories, they are either eye-safe or not eye-safe. A high-output IR illuminator capable of extreme distances can be so bright at the source that they exceed eye-safe limits. A distant subject, however, may not be at risk of eye injury when looking toward the same illuminator.

Each person using IR illuminators is responsible for acquiring the requisite knowledge and product specifications to use them safely. Using an IR illuminator from comparatively close to a subject permits using a lower-output eye-safe illuminator and yet adequately illuminate the subject. The ALS-40 Infrared Illuminator provided by Sofradir EC, Inc. with its Class 1 eye-safety rating (IEC-60825-1) is eye-safe under conditions of normal use (refer back to Figure 5-44, right image).

In-House Fabrication of Infrared (IR) Illuminators

Placing Infrared Transmitting (IRT) Plexiglas® over the lens of a high-output handheld spotlight is an inexpensive way to make a long-range infrared (IR) illuminator.

The surveillance specialist can purchase infrared (IR) illuminators or make them. They can make IR illuminators by applying an infrared (IR) transmission filter to a high-output handheld spotlight, or fabricate a housing to contain an IR filtered spotlight bulb. Infrared (IR) transmission filters

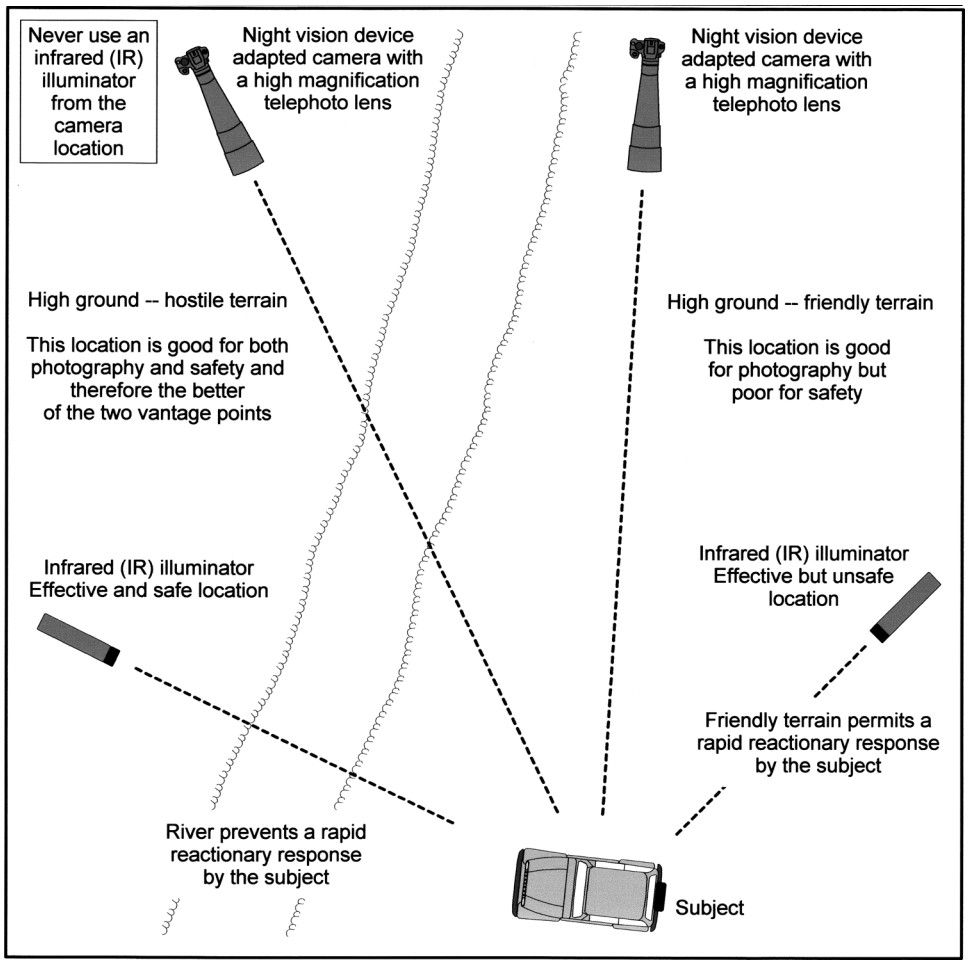

Figure 5-49. The closer the infrared (IR) illuminator is to the subject, the more brightly the subject is illuminated. Unfortunately, limited illuminator-to-subject distance increases the likelihood of discovery and it complicates escape and evasion. Locating the IR illuminator remote from the camera location serves two primary purposes. First, it prevents illuminating the atmosphere between the camera and subject location. That ensures image clarity. Second, detection of the IR illuminator by the subject leaves the existence and location of the photography team undisclosed. In that respect, the IR illuminator can serve as a decoy. In this example, relative to the upper left vantage point, the river and hostile terrain makes a rapid reactionary response by the subject difficult should discovery of the photography team occur.

block visible light while passing the near infrared frequencies to which third generation (Gen 3) image intensifier night vision devices (NVDs) are responsive.

Handheld spotlights featuring a quartz halogen bulb produce a spectrum of light that begins at near ultraviolet and extends well into the near infrared region of the electromagnetic spectrum. Placing an IR transmission filter on the spotlight transforms it into a high-output IR illuminator.

When used for photography, the effective range of an in-house fabricated IR illuminator depends on a number of factors such as the light output of the spotlight, the visible light cut-off point of the IR filter, the f-ratio of the optical system, and atmospheric conditions.

The authors made an IR illuminator by placing Infrared Transmitting (IRT) Plexiglas over the lens of a 3,000,000 candlepower handheld spotlight. The IR illuminator provides strong illumination at 0.40 kilometer (0.25 mile) and usable illumination at 0.475 kilometer (0.295 mile).

In the early 1970s, for long-range 16mm infrared motion picture filming, one of the authors made an IR illuminator using an aircraft landing light and a Kodak gelatin Wratten infrared filter #87. It worked well. Today, better bulb choices exist. One bulb worth investigating is the GE Halogen spotlight bulb (Part Number 13233) intended for stage and studio lighting. The 120-volt 1,000-watt bulb provides 400,000 lumens. GE does not specify the beam spread rating of the bulb offering only that it is a "Very Narrow Spot." The authors have not experimented with this specific bulb, but the specifications are encouraging. In the field, for extended outdoor use, power 120-volt bulbs using either a 12-volt battery pack and inverter or a small portable generator.

IR illuminators made from handheld spotlights do not feature the beam uniformity and consistent distribution of illumination characteristic of commercially manufactured IR illuminators. Nevertheless, results are acceptable and apparatus cost is low. To minimize irregular illumination, consider multi-fixture/zone overlap illumination. That is, illuminate the subject from one location using two IR illuminators mounted side-by-side or have two assistants illuminate the subject from two different locations.

Infrared (IR) camera filters are available, but they are small. Gelatin IR filters generally measure no more than 101.6 x 101.6 millimeters (4 x 4 inches) square. Circular glass IR filters are available, but most do not exceed 82 millimeters (3.23 inches) in diameter. The price of gelatin IR filters is reasonable, but circular glass IR filters are expensive.

Ridout Plastics Co. Inc. located in San Diego, California (USA), sells sheets of Infrared Transmitting (IRT) Plexiglas in a variety of sizes up to 1.22 x 2.44 meters (4 x 8 feet). They measure 3.175 millimeters (0.125 inches) thick. The spectral transmission of the IRT Plexiglas is principally the same as that of a Kodak gelatin Wratten infrared filter #87. The visually opaque plastic passes frequencies in the near infrared region but blocks ultraviolet

(UV) in the range of 240–400 nanometers, blocks visible light in the range of 400-700 nanometers, and begins transmitting infrared (IR) at 740 nanometers. It transmits 85–90 percent in the 800–1200 nanometer range. The manufacturer's website cautions: "Please call one of our industrial salesmen for availability before ordering." For product details, visit the manufacturer's website (www.eplastics.com).

Infrared (IR) illuminators made using a Number 87 infrared camera filter or IRT Plexiglas exhibit a weak red glow at the source. The nature of the environment at the location of the subject and at the location of the IR illuminator determines the likelihood of visual detection by the subject. If necessary, cover the IR filter with a honeycomb antireflection device (ARD) to minimize the likelihood of detection. The ARD prevents light reflection from the smooth filter surface and it leaves the red glow visible only to people within the ARD field-of-view. Unfortunately, an ARD reduces maximum range. For complete covert use, for the illuminator to be invisible to unaided human vision, blockage of visible light up to approximately 950 nanometers is necessary. A commercially manufactured IR illuminator featuring visible light blockage up to 860 nanometers emits a visually detectable weak red glow.

When using Infrared Transmitting (IRT) Plexiglas to make an IR illuminator, experiment to determine if the heat from the bulb is sufficient to soften the plastic. Plexiglas is a thermoplastic (thermosoftening plastic). It is a polymer that becomes soft when heated and with sufficient heat applied, it becomes liquid. The manufacturer advises that the IRT Plexiglas becomes soft at about 82° Celsius (180° Fahrenheit).

HIGH ISO AVAILABLE LIGHT PHOTOGRAPHY VERSUS NIGHT VISION PHOTOGRAPHY

The tendency is to think that the level of ambient illumination determines if the surveillance specialist will do high ISO available light photography or do night vision photography, that it is an either-or situation. The reality is that circumstances as much as the level of ambient illumination determines which method to use. One surveillance specialist may successfully photograph a subject using high ISO and available light while a second specialist photographing the same subject at the same time must photograph using an image intensifier night vision device. That sounds contradictory even though it is not.

Some nighttime illumination levels are such that the surveillance specialist can photograph the subject from a short to moderate distance without

an image intensifier night vision device, photographing with high ISO and a fast telephoto lens. Consider the Canon and Nikon 200mm f/2, 300mm f/2.8, and 400mm f/2.8 telephoto lenses to be short and fast. The same subject can require using an image intensifier night vision device when photographed from a long distance using a high-magnification optical system featuring a small f-ratio. The small effective f-ratio of high-magnification optical systems often provides an image too dim for an adequate shutter speed and therefore using an image intensifier night vision device to increase image brightness is necessary (see Figure 5-50 and refer back to Figures 5-26 and 5-39).

In some instances, two surveillance specialists may photograph from the same distant vantage point with one specialist doing night vision photography and the other doing conventional photography. For example, when photographing from an extreme distance, 0.80 kilometers (0.50 mile) or more, the required magnification results in a comparatively slow optical system. One specialist uses a night vision device with a telescope by means of afocal coupling, or photographs using the *SCT-Configured AstroScope* or the *Special-Order Battery-Adapted AstroScope.* The specialist uses night vision technology to achieve an image bright enough to use a shutter speed adequate to freeze movement of human subjects. Without a night vision device, the second specialist records high-resolution low ISO time exposures of stationary subject matter such as vehicles and their number plate. In some instances, from a low elevation vantage point, near-ground thermal activity neutralizes the benefit of high-resolution low ISO time exposures. Always, when possible, photograph from a high-elevation vantage point (refer to Figure 7-1 and accompanying text in Chapter 7).

A secondary benefit results from the simultaneous use of night vision photography and conventional photography. During night vision photography, recording detail such as subject identification (i.e., facial recognition) and legible vehicle number plates requires high magnification. That is, the subject must fill a significant portion of the frame, which results in limited area of coverage. Conventional photography permits recording useful detail with less magnification. Hence, conventional photography permits recording a greater area while still documenting important details such as vehicle number plates. In the final analysis, in instances such as this, night vision photography documents moving people while conventional photography documents the larger scene and stationary subject matter.

Never photograph from a long distance using an image intensifier night vision device when circumstances permit short- to intermediate-range night vision photography. Similarly, never photograph from a long distance using a night vision device when circumstances permit short- to intermediate-range

Figure 5-50. Both images are nighttime photographs of subjects in the same municipal park but at slightly different locations although the illumination level is similar. The camera-to-subject distance and photographic method is different for each. The left image is a moderate-range high ISO conventional photograph and the right image is an ultra-long-range night vision photograph. The man in the left image was photographed from a distance of approximately 122 meters (133 yards) using available light and a 300mm f/2.8 telephoto lens on a Canon EOS 5D digital single-lens reflex full-frame camera. *ISO:* 3200. *Aperture:* f/2.8. *Shutter speed:* 1/6 second. Magnification is 6x. The three people in the right image were photographed using 102x magnification from a distance of 1.03 kilometers (0.64 mile). The effective focal length and f-ratio of the optical system was 5078mm f/16.66 with an image intensifier night vision monocular used to increase image brightness. *ISO:* 100. *Shutter speed:* 1/13 second. Illumination in the park was adequate for high ISO available light photography using a short fast lens but not adequate for a slow ultra high-magnification optical system. The high magnification but slow optical system required using a night vision device to increase the brightness of the image. *Right image method:* Night vision image recorded using the full-frame Canon EOS 5D digital single-lens reflex camera, 3048mm f/10 12″ Meade LX90GPS Schmidt-Cassegrain telescope with a 15mm eyepiece, and NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device featuring a 25mm objective lens (objective lens focal length estimated because the exact focal length is undisclosed by the manufacturer). Effective focal length and f-ratio (aperture) of the optical system was, as stated, 5078mm f/16.66. The effective f-ratio difference between the two optical systems featured here, f/2.8 and f/16.66, is slightly more than five stops, specifically 5.1458 stops. *Note:* A Gen 3 night vision device provides an advantage of approximately eight to ten stops.

photography using a fast lens and high ISO (without a night vision device). Never photograph from farther than necessary, day or night. Unfortunately, photographing from short to intermediate distances is not always possible for reasons that include but are not limited to the following:

- It is a high countersurveillance environment.
- The subject is too dangerous to justify the risk of detection by doing short- to intermediate-range photography.
- No suitable vantage point exists near the subject.
- The environment is such that escape and evasion would be difficult if discovered working in close proximity to the subject.
- No defensive positions exist to which the photography team can retreat if discovered working in close proximity to the subject.
- The sensitive nature of the case is such that under no circumstances must discovery occur.
- Plainclothes personnel need distance for cover to preserve their anonymity.

In the rural environment, limited camera-to-subject distance increases the danger of discovery by means of sight, sound, shine, shape/outline, contrast, smell, or movement. Limited distance also increases the likelihood of discovery by a security patrol and it increases the potential that the subject will later discover evidence of the surveillance via various indicators (e.g., footprints and disturbed foliage). The subject discovering evidence of past human presence at a location of 1.21 kilometers (0.75 mile) or more away is likely to assume that the human presence was unrelated to him or her. In the urban environment, limited distance can also result in somebody who is friendly with the subject discovering the surveillance. Finally, limited distance can result in compromise when discovered by domestic animals owned by the subject or other people residing in the area.

VIGNETTE IMAGES

Many photographers object to vignette images. It is understandable why photojournalists and photographers of wildlife, sports, fashion, and portraits object to vignetting. However, for investigation and intelligence purposes, vignetting is of no consequence because the objective is to record essential information. Whether such images are aesthetically pleasing is irrelevant.

Sofradir EC, Inc. designed the standard AstroScope to provide an image circle compatible with the Nikon DX format, which is slightly larger than the APS-C format that Canon uses, both being crop-sensors. No vignetting occurs when using the AstroScope with DX format and APS-C format crop-sensor DSLR cameras. Vignetting does occur when using the AstroScope with larger format DSLR cameras. No vignetting occurs when doing afocal photography using a monocular night vision device with a crop-sensor

DSLR camera, but vignetting does occur when using a full-frame DSLR camera for afocal photography (see Figure 5-51).

Sofradir EC, Inc. offers a *full-format adapter* that permits recording vignette-free images when using the standard AstroScope with a full-frame Canon or Nikon digital single-lens reflex camera. It accomplishes that by increasing the size of the image circle to cover the large full-frame image sensor. Unfortunately, increasing the size of the image circle reduces its brightness, which can be a detriment during clandestine photography. For some applications such as recording news footage, vignette-free images are desirable. However, for manual clandestine photography, a brighter image reaching the faceplate of the intensifier tube is usually more important than eliminating vignetting. In spite of its limitations for clandestine photography, a full-format adapter is worth having in one's inventory of options, but be aware of its limitations and use it accordingly.

LIGHTS IN THE FIELD-OF-VIEW

To keep the light output constant, the image intensifier tube in a night vision device will automatically gain up and down as illumination level changes.

Most third-generation (Gen 3) image intensifier night vision devices feature Automatic Brightness Control (automatic intensifier tube gain). That technology automatically adjusts intensifier tube gain to keep the intensifier's light output constant. This is, to keep the brightness of the green phosphor screen image almost constant within defined limits (e.g., 2–4 fL or <2 cd/m^2). Without automatic brightness control, people using a night vision device may be temporarily blinded by flashing lights. Conditions that affect gain are the ambient level of illumination, lights in the field-of-view, and the predominant color (reflectivity) and brightness of the scene (see Figure 5-52).

MANAGEMENT OF BLOOMING AND LENS FLARE

How well an optical filter (absorptive filter) minimizes blooming depends on the spectral power distribution and wattage of the illumination source, the spectral cut-off point of the filter, and the spectral response of the image intensifier night vision device.

Introduction

Photography using an image intensifier night vision device (NVD) is challenging. Many issues requiring management during traditional daytime

Figure 5-51. Vignetting occurs when using the standard AstroScope Night Vision Module (and AstroScopes configured for SCT-based photography) with a full-frame DSLR camera (upper left image) but not when using it with a crop-sensor DSLR camera (upper right image). Vignetting occurs when using a monocular night vision device by means of afocal coupling with a full-frame DSLR camera (lower left image) but not when using it with a crop-sensor DSLR camera (lower right image). *Upper left image:* Image recorded from 161 meters (176 yards) using a standard AstroScope with the Canon EOS 5D DSLR full-frame camera and Canon EF 600mm f/4L IS USM telephoto lens. *Upper right image:* Image recorded from 342.9 meters (375 yards) using the Special-Order Battery-Adapted AstroScope with the Canon EF 70-300mm f/4-5.6 IS USM telephoto zoom lens at full zoom and Canon EOS 30D DSLR crop-sensor camera. *Lower left image:* Image recorded from 1.03 kilometer (0.64 mile) by means of afocal coupling using the ITT NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device, Canon EOS 5D digital single-lens reflex full-frame camera, and 3048mm f/10 Meade 12″ LX90GPS Schmidt-Cassegrain telescope. *Lower right image:* Image recorded from 0.43 kilometer (0.27 mile) by means of afocal coupling using the ITT NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device, Canon EOS 30D digital single-lens reflex crop-sensor camera, and 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope.

photography also exist during night vision photography, but additional issues require management. For example, what the unaided eye sees as a small light reflection from a reflective surface can be a significant reflection when viewed using a Gen 3 image intensifier night vision device that amplifies light about 40,000 times. Additionally, lights outside the field-of-view can appear insignificant to the unaided eye but they can cause the NVD to gain down resulting in a darkened view of the subject area. The same lights can cause a lens flare problem during night vision photography. In addition to these challenges, blooming sometimes obscures important portions of a

Figure 5-52. Lights and bright surfaces within the scene affect Automatic Brightness Control (automatic intensifier tube gain), which helps or hinders depending on what the surveillance specialist needs to photographically document. Observe the "blooming" around the lights. These images are unworked except for converting them from color to grayscale (black and white). The images are as they appeared on the green phosphor screen of the night vision device and as the camera recorded them with no postphotography editing to enhance or alter the image. The AstroScope used to record these images does not feature manual variable gain. The images are cropped top and bottom to fit page format. In the upper image, the lower left lights are the headlamps of a passing motor vehicle. *Camera-to-subject distance:* 0.46 kilometer (0.29 mile). *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* Canon EF 200mm f/2.8L II USM telephoto lens with a 1.4x tele-converter. *Effective focal length and f-ratio (aperture):* 280mm f/4. *Night vision device:* Special-Order Battery-Adapted AstroScope. *ISO:* 100. *Exposure duration, top down:* 1/60th second, 1/20th second, 1/10th second. *Mounting system:* Kirk Multi-Purpose Window Mount, ball head, and Manfrotto telephoto lens support.

scene. Depending on the spectral power distribution of the offending lights, the surveillance specialist may or may not be able to minimize or eliminate blooming by use of an appropriate filter. The blooming around fluorescent lights responds well to bloom reduction efforts using optical filters (absorptive filters). The blooming around lights that emit near infrared frequencies is resistant to reduction by means of filters.

Minimizing Blooming

> The human eye features a spectral response of about 400–700 nanometers (nm). The spectral response of third generation (Gen 3) image intensifier night vision devices is about 450–950 nanometers (nm).

Minimizing blooming during night vision photography is sometimes possible by using optical filters (absorptive filters) to block certain frequencies of light. The spectral power distribution of a light source determines how well filtration minimizes blooming. At this time, it appears that fluorescent lights respond best to light filtration and because of their energy efficiency, their use is becoming increasingly prevalent. That is good news for surveillance specialists who sometimes need to minimize blooming during night vision photography.

Anybody who has used an image intensifier night vision device is familiar with blooming. Blooming is the bright glow around light sources in the field-of-view. Although blooming occurs with all image intensifier night vision devices, the extent of blooming is less severe with auto-gated third-generation (Gen 3) NVDs, yet they do exhibit blooming. Morovision Night Vision, Inc. defines blooming as:

> Loss of the entire night vision image, parts of it, or small parts of it, due to intensifier tube overloading by a bright light source. Also, known as a "halo" effect, when the viewer sees a "halo" effect around visible light sources. When such a bright light source comes into the night vision device's view, the entire night vision scene, or parts of it, become much brighter, "whiting out" objects within the field-of-view. (Morovision Night Vision, Inc., 2011, n.p., *Blooming*)

Many third-generation (Gen 3) image intensifier tubes manufactured by ITT Night Vision feature an auto-gated power supply that reduces the extent of blooming, although it does not eliminate it. Morovision Night Vision, Inc. explains the term auto-gated as follows:

> When the power supply is "auto-gated," it means the system is turning itself on and off at a very rapid rate. This, combined with a thin film attached to the microchannel plate (an ion barrier) reduces blooming. (Morovision Night Vision, Inc., 2011, n.p., *Auto-Gated Power Supply*)

Using an image intensifier night vision device for photography in urban environments can be frustrating when blooming obscures portions of the scene. In some instances, photographing from a location that excludes lights from the field-of-view eliminates the problem. Unfortunately, circumstances do not always permit excluding lights from the field-of-view and often lights exist at the subject location so excluding them from view is not possible. Additionally, even when excluding lights from the lens's field-of-view is possible their close proximity to the subject sometimes causes the intensifier tube to gain down and that darkens the image.

Depending on the spectral power distribution of lights in the field-of-view, the surveillance specialist can sometimes minimize or eliminate blooming by using a filter to block certain frequencies of light while permitting the passage of other frequencies. When using optical filters (absorptive filters) for this purpose, an advanced knowledge of the science of light (optical engineering degree) would be helpful. However, rare is the surveillance specialist with such knowledge. Alternatively, the specialist records a few test images of the subject area with and without filters to determine if light filtration will provide a desired result.

Although more experimentation is necessary relative to the use of optical filters (absorptive filters) to minimize blooming, preliminary testing suggested that light filtration works best with fluorescent lights. The filter blocks light frequencies emitted by fluorescent lights while passing frequencies to which image intensifiers are most sensitive.

Blooming around fluorescent lights tends to be manageable because their spectral power distribution is primarily in the visible light region with very little output in the near-infrared region (refer back to Figure 5-5 and refer ahead to Figure 5-53). Using an appropriate infrared filter excludes visible light and that leaves the night vision device (NVD) almost blind to fluorescent lights. Incandescent lights are difficult to control using optical filters because they are broadband. That is, they produce a spectrum of light that begins at near ultraviolet and extends well into the near infrared region of the electromagnetic spectrum.

The surveillance specialist serious about the potentials of light filtration for night vision photography needs to experiment with color subtraction filters and infrared (IR) transmitting filters. Preliminary tests using a #25 red filter, #29 dark red filter, #89B infrared filter, #87 infrared filter and #87C infrared filter produced informative results. Results suggest that light filtra-

tion offers the greatest potential relative to blooming around fluorescent lights, which emit little in the near infrared region of the electromagnetic spectrum, as stated.

The outdoor wall lanterns on the house in the next illustration serve well for illustration purposes because they contain low-, intermediate-, and high-watt compact fluorescent light bulbs (CFL). The wattage of the bulbs affected the extent of blooming reduction when using optical filters (absorptive filters) to block certain light frequencies while passing others (see Figure 5-53). In this instance, the #25 and #29 filters provided no advantage. The #89B infrared filter reduced blooming around the intermediate and high watt fluorescent light bulbs and eliminated most of the blooming around the lowest watt bulb. The #87 and #87C infrared filters eliminated blooming around the fluorescent light bulbs but not around the streetlight, which emits near-infrared frequencies. In this instance, the #87 filter is preferred over the #87C filter because it eliminates blooming around fluorescent lights just as well and it does not reduce shutter speed as much.

In many instances, the surveillance specialist does not know what kind of bulbs are in light fixtures, but that is not a problem. During nighttime reconnaissance, the specialist photographs the area without a filter and then records additional images using various filters. When recording test images, it quickly becomes apparent whether using a filter will reduce or eliminate unwanted blooming. As fluorescent bulb use becomes more prevalent, the opportunity to use filters to manage blooming will increase. Do not overlook the feasibility of using a spotting scope or telescope to examine light fixtures because sometimes an enlarged view reveals the type of bulb they contain. A daytime and nighttime telescopic view may be required.

Further experimentation remains necessary relative to light filtration to manage blooming around different types of light bulbs. For example, the authors have not yet experimented with light filtration relative to blooming around yellow incandescent and fluorescent bug lights.

Lens Flare

When photographing with an image intensifier night vision device, preventing lens flare is sometimes a challenge. Lens flare is the scattering and reflection of light within the lens system caused by extraneous light entering the lens from outside the lens's field-of-view. A Gen 3 night vision device amplifies the scattering light by about 40,000 times. Depending on circumstances, consider the following measures to prevent or minimize lens flare.

- Prevent light entering the lens from an angle outside the lens's field-of-view.

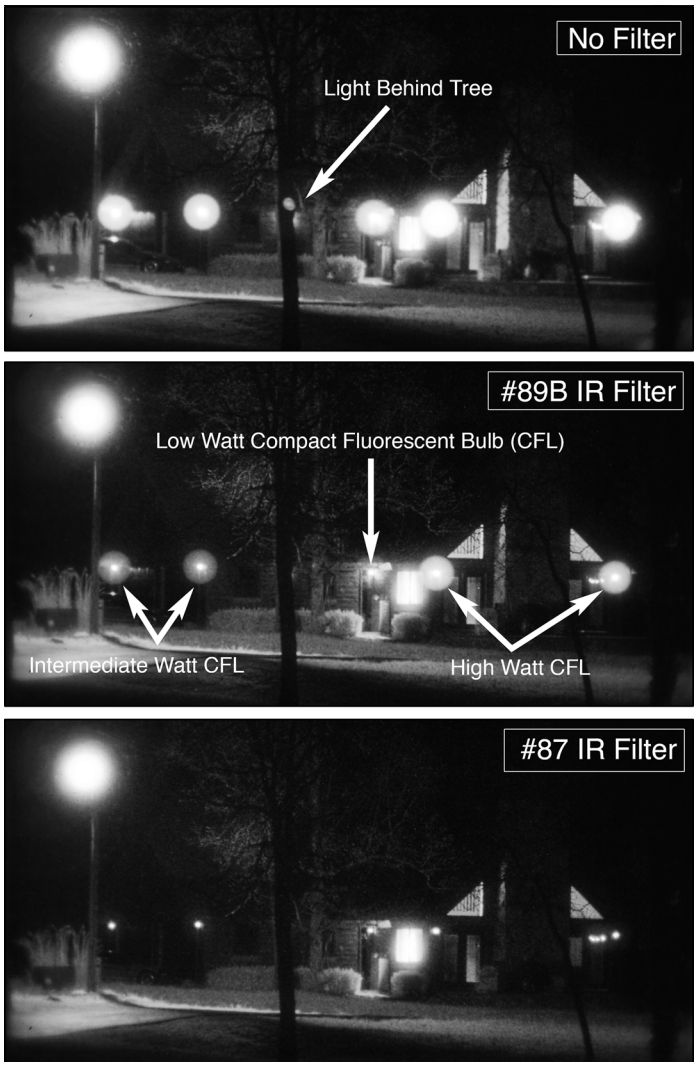

Figure 5-53. In some instances, the surveillance specialist can reduce or eliminate blooming by using an optical filter (absorptive filter) to block certain frequencies of light while passing other frequencies. When blooming is a problem, record a series of test exposures using various filters to determine if a particular filter provides desired results. This house features several exterior wall lanterns containing low-, intermediate-, and high-watt compact fluorescent light bulbs (CFL). *Upper image:* Night vision image recorded using no filter. *Center image:* Night vision image recorded using a #89B infrared filter. The third CFL bulb from the right features minimal blooming. It is a low-watt bulb. *Lower image:* Night vision image recorded using a #87 infrared filter. Observe that this infrared filter failed to reduce blooming of the streetlight but virtually eliminated blooming around the compact fluorescent light bulbs (CFL) in the wall lanterns mounted to the house. Finally, observe in each image the extent that a tree in the line-of-sight between the camera and one of the bulbs eliminates blooming.

- If the offending light is a fluorescent bulb, experiment using the optical filters (absorptive filters), discussed above, to eliminate the visible frequencies.
- Locate the camera so that something such as part of a building excludes the offending light bulb from view.
- Use a suitable lens shade, or use an antireflection device (ARD) featuring a light-spread rating that matches the angle-of-view of the lens. Try using a lens shade and ARD together.
- Adjust framing so that undesirable light sources are outside the field-of-view.
- Use a lens with a focal length great enough to exclude light sources from the field-of-view. This and the previous method work best when also using a suitable lens shade or ARD.

NIGHT VISION PHOTOGRAPHY TIPS: SUMMARY OF KEY POINTS

At the time of this writing, Morovision Night Vision, Inc. is developing a variety of field kits. Periodically visit their website to view currently available kits (www.morovision.com).

This chapter provided considerable information about night vision photography and videography. The following is a summary of key points:

- Clandestine night vision photography usually requires disabling all camera functions that emit visible light, infrared frequencies, and sound.
- Use manual exposure mode, not aperture or shutter priority, or program mode.
- Ensure "perfect" exposure. Record a series of test exposures using each camera intended for night vision photography. Each camera is different. For example, when using the Canon EOS 5D digital single-lens reflex full-frame camera with the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device, one stop more exposure is necessary than the camera internal light meter indicates is needed for proper exposure.
- Record a series of test exposures to identify the most efficient camera for night vision photography, especially when using elevated ISO is necessary. Some digital cameras inherently perform better for night vision photography and some are more tolerant of elevated ISO during night vision photography than others are.

- For night vision photography using afocal coupling determine the ideal optical system and camera combinations.
- During night vision photography, underexposure degrades image quality. Do not underexpose to increase shutter speed. Underexposing to increase shutter speed is a method that works with conventional low-light high ISO available light photography, but it does not work well during night vision photography.
- Focus the host lens manually to achieve perfect subject specific focus.
- During long-range night vision photography, operating the camera by means of an electronic or mechanical remote shutter release is essential. Operation of the camera must occur without touching it when using high-magnification optics. Remember that during extreme distance night vision photography the effective focal length can exceed 5,000 millimeters.
- Use the fastest lens that circumstances permit. Unfortunately, high magnification is necessary when photographing from extreme distances and high-magnification optics tend to be comparatively slow. That is, they feature a small f-ratio. Nevertheless, some camera-to-subject distances permit using afocal coupling to configure a fast optical system and still have adequate magnification. *Example:* For a distance requiring a focal length of approximately 1,000 millimeters and the low illumination level requires maximum f-ratio (maximum lens speed), use a high-magnification Schmidt-Cassegrain telescope and reduce effective focal length and increase f-ratio via afocal coupling. In this instance, use the 3048mm f/10 Meade LX90-SC Schmidt-Cassegrain telescope with a 50mm telescope eyepiece and an f/6.3 focal-reducer, using it with the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device. The effective focal length and f-ratio of that electro-optical system is 960mm f/3.15. Focal length is only 4.2 percent less than the desired 1,000 millimeters but the effective f-ratio is 3 1/3 stops greater than f/10.
- For afocal night-vision photography, always use high quality telescope eyepieces.
- During afocal night-vision photography, ensure perfect alignment of all optical components and experiment with spacing to achieve best results.
- When using a Schmidt-Cassegrain telescope, ensure perfect collimation.
- When increasing magnification is necessary during afocal photography using a conventional telephoto lens (i.e., Canon or Nikon), apply a tele-converter before using a shorter focal length telescope eyepiece.

Experiment to determine what focal length eyepiece and tele-converter combination works best under the circumstances relative to image quality and magnification needs.

- When greater magnification is required while using an SCT-Configured AstroScope for extreme-distance night vision photography, use a greater focal length Schmidt-Cassegrain telescope (SCT) before resorting to tele-converter use. Greater focal length increases image size without reducing f-ratio; tele-converters reduce effective f-ratio. *Example:* The surveillance specialist using the 3048mm f/10 12″ Meade LX90-SC SCT needs approximately one-third more focal length. She can use the telescope with a 1.4x tele-converter and achieve an effective focal length of 4267mm, but f-ratio diminishes to f/14, a loss of one stop. Alternatively, she decides to photograph using the 4064mm f/10 16″ Meade LX200-ACF telescope. Focal length is 33 percent greater and the f-ratio is still f/10. She acquired the necessary magnification increase while avoiding an f-ratio loss of one stop.
- Celestron EdgeHD telescopes feature a flatter focal plane than traditional Schmidt-Cassegrain telescopes do, the latter characterized by field curvature. The Celestron website explains that the "New aplanatic Schmidt telescope design produces aberration-free images across a wide field-of-view" (Celestron, 2011, n.p., *CGE PRO 925 HD*). An aplanatic optical system is free from or corrected for spherical aberration.
- Meade LX200-ACF Series telescopes feature a flatter focal plane that traditional Schmidt-Cassegrain telescopes do, the field of this telescope series rivaling that of traditional Ritchey-Chrétien (RC) telescopes.
- During night vision photography, maximum aperture is usually necessary unless the level of ambient illumination is high. When illumination is too high, reduce incoming light by using a smaller lens aperture. If the lens is a telescope and therefore lacks an adjustable aperture, use a neutral density filter to reduce the level of incoming light.
- When the spectral power distribution of lights permit, use optical filters (absorptive filters) to block certain frequencies of light to reduce or eliminate blooming.
- During night vision photography, ISO affects image quality so use as low an ISO as conditions permit.
- When using an image intensifier night vision device (NVD) featuring manual variable gain control, use the minimum level of gain that circumstances permit. Experimentation is necessary to find the relationship between manual variable gain level and camera ISO that optimizes image quality while providing a suitably fast shutter speed.

Elevated manual variable gain tends to degrade image quality more than elevated ISO does.

- Maximize image quality by tripod mounting the camera adapted night vision device, or use some other support system such as a window mount, table mount, or tree-mount support.
- When the camera adapted night vision device is on a stable support, use the camera's mirror lock-up feature to avoid vibrations caused by the action of the mirror. Alternatively, use the camera *electronic first shutter curtain* to avoid vibration caused by the action of the mirror, focal-plane shutter, and drive motor.
- When handholding a camera-adapted night vision device use a gyro-stabilizer.
- Shutter speed must be fast enough to freeze movement of human subjects to prevent blurred images. A shutter speed of 1/30 second is adequate for that purpose, although much slower shutter speeds are possible. When using a slow shutter speed, record numerous sequential images so that some exposures occur when the subject pauses and is motionless, or is moving towards the camera. When the camera-adapted night vision device is on a solid support, recording numerous sequential images using a shutter speed as slow as 1/2 second or less often results in acquiring a percentage of usable images. Most images are not usable, but many are.
- Image stabilized lenses minimize unwanted image movement when handholding the apparatus. Tripod mounting some telephoto lenses requires deactivating the image stabilization feature.
- Exclude manmade lights from the field-of-view–select a vantage point accordingly. A night vision device responds to bright lights by reducing gain. Moreover, a prolonged bright light in the field-of-view can damage the intensifier tube.
- Use an infrared (IR) illuminator when necessary, but locate it remote from the camera and well removed from the line-of-sight between the camera and subject. Remember that activating an IR illuminator takes one from the *passive* to the *active* mode. Once active, anybody using a night vision device for countersurveillance can detect the IR illuminator.
- Maximize camera elevation to avoid photographing through near-ground thermals.
- Photograph over thermal friendly terrain when circumstances permit.
- Thermal equilibrium of the lens is important for maximum image quality, this being especially important when using a Schmidt-Cassegrain telescope (SCT). Set up the apparatus early enough to provide the telephoto lens or telescope time to achieve thermal equilibrium.

Best image quality occurs when the optical elements within a lens system, and the lens tube, are the same temperature, and when their temperature is consistent with the ambient temperature. When ambient temperature is rising or declining, achieving complete thermal equilibrium is not possible.

- Preventing dew formation on optical and electro-optical equipment is important. A dew shade (lens shade) delays dew formation on the front element of a telephoto lens or telescope.
- In addition to using a dew shade, prevent dew formation on the optical and electro-optical equipment by keeping them warmer than the dew point temperature. Accomplish that using one of the following methods.
  - The Astrozap® Dew Controller system keeps the temperature of the optical system above the dew point temperature.
  - Air activated chemical hand warmers will keep the temperature of the optical system above the dew point temperature. Apply the hand warmers using strips of cloth or some other suitable method. Consider making strips of cloth featuring hand warmer pockets and Velcro tabs on the ends for this purpose.

ENDNOTE

Advice for Surveillance Specialists

This chapter discussed short- to long-range image intensifier night vision photography, some methods being groundbreaking. Nevertheless, the effort to find more efficient and effective application methods should not end here. Current methods can be refined and greater potentials await discovery. Elevating the craft of clandestine night vision photography and videography requires motivation and knowledge and above all imagination. Never consider the current state of the craft as being adequate or finite. Never settle for mediocrity or embrace the defective view that good enough is good enough. Rather, seek improved methods and never hesitate to try something new even if it seems unlikely to work.

Every time curiosity results in wondering if some unorthodox photographic technique will work, try it and see what happens. Try it, even if the idea seems outlandish. It may work, but if it does not work, nothing is lost but knowledge results. In many respects, knowing what does not work is as valuable as knowing what does work, especially when trying to make improvements.

Be curious, creative, and brave. There are few absolute rules of photography. Sometimes things that should not work do work. Some things work even when the conventional rules of photography say it is wrong and will not work. The training DVD *Digital Photography, Crafting Images* affirms this, reporting that, "there are no photographic concepts or rules that can't be challenged" (Ratty, 2004). The great American inventor Thomas Alva Edison (1847–1931) once said, "I have not failed. I've just found 10,000 ways that won't work" (BrainyQuote®, 2010, n.p., *Thomas A. Edison quotes*). Every time Edison tried something that did not work, he acquired knowledge and understanding that furthered his research. Seek knowledge and understanding, and experiment with new ideas even when they seem outrageous–they may work!

Advice for Manufacturers and Distributors

> Imagining something is prerequisite to creating it. Similarly, recognizing a need is prerequisite to finding a solution to satisfy the need. The brilliant theoretical physicist Albert Einstein (1879-1955) said, "Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand." (Rayme, 2011, January 10, n.p.)

Regarding the above epigraph, if a person has technical knowledge but lacks imagination, he or she is poorly equipped to make advancements in their chosen field. Conversely, the person with imagination realizes when something greater is required and they determine what is necessary to accomplish it. Then they appeal to the person with the requisite technical knowledge to work out the design details. Somebody must envision it before somebody can make it. Manufacturers must understand that the needs of end users must drive research and development (R&D).

Maximizing product capability and usefulness is not possible without insight into the needs it must satisfy. Too often, it appears that manufacturers focus on the technology while not fully considering end user needs and the importance of effective and efficient field application methods. The latest technologies are of little or no use until developing ways to apply them in the field.

Night vision photography and videography begs further research and development (R&D), especially relative to application methods under challenging field conditions. Manufacturers need to advance night vision technology, to be sure, but they must place equal emphasis on application methods and that includes the development of essential accessory products. The needs of field personnel must drive R&D efforts. That is, actual needs not perceived needs.

Scientists and engineers cannot create products that best meet the night vision photography needs of field personnel if they are unaware of end user needs. End users, it appears, have tended to accept the limitations of night vision products because they assumed that manufacturers, being the experts, developed products to the extent that the prevailing technologies permitted. The best product without an effective and efficient means to apply it in the field avails less than it could and should. That negatively affects the end work product and marketability of the technology. When an agency purchases a product only to suffer disappointment, future purchases are unlikely. Additionally, negative word-of-mouth advertising hurts future sales.

Need is the mother of invention. The authors, who are end users that saw a need, took night vision photography from the inadequate standoff distance of a little more than 274 meters (300 yards) to a distance so great that photographing from the lesser distance of 0.80 kilometer (0.50 mile) is no challenge. However, night vision photography R&D must not end with their accomplishments.

Need must drive R&D and that requires an effective and efficient system for obtaining feedback and input from end users. However, end users must believe that the manufacturer wants to hear from them or feedback will not be forthcoming. When that occurs, the feedback system will fail and exist in name only. Lack of communication between manufacturer and end user can have far-reaching implications. Product development will suffer and the inability to influence product development will impede maximizing field tradecraft. It is a cyclic situation.

To make progress to the extent possible, R&D teams must feature competent leadership and a suitable mix of scientists, engineers, and people with appropriate clandestine photography experience. Above all, every team member must think outside the box, figuratively speaking. That is, they must think creatively without permitting tradition to confine them. They must forever be alert for what other technologies and methodologies can contribute, and they must be results driven. Overemphasizing this point is not possible! A person with field experience can recognize a need and determine what will satisfy the need. The scientist and engineer then address the design details and hopefully during that process, they will enhance the capability of the new product beyond what the field person envisioned. That is precisely the situation that gave birth to the SCT-Configured AstroScope and the Special-Order Battery-Adapted AstroScope.

Once introducing a new and enhanced product to the market, the marketing people must become educators, not simply order fillers. They must educate end users so that they know what the product is capable of, how product capability will satisfy their needs, and how to use the product effec-

tively and efficiently. During the process of teaching, the manufacturer will acquire valuable feedback from end users relative to their ongoing needs. Indeed, needs change as the social, criminal, and political climate changes. As stated, an active (not passive) system for obtaining consumer feedback must be in place.

When writing this first edition, the authors invested considerable effort to finding ways to increase night vision photography standoff distances. That is, for recording essential detail such as recognizable images of human subjects and legible vehicle number plates from long distances. That was necessary because initially standoff distance was too limited to be useful for clandestine applications, in most instances. When writing the second edition revision, an area of emphasis will be enhancing field application methods, finding ways to manage difficult field conditions. The ability to record usable night vision images under virtually all nighttime conditions, no matter how troublesome, is an area wherein a great deal of work remains.

Chapter 6

TACTICS AND STRATEGIES FOR MANUAL CLANDESTINE PHOTOGRAPHY OPERATIONS

During all phases of surveillance, be alert for countersurveillance. Manual clandestine photography frequently occurs in a hostile and active countersurveillance environment.

INTRODUCTION

The purpose of this book is to teach the fundamentals of manual clandestine photography–this is a photography book. Nevertheless, addressing tactics and strategies is necessary because they are essential supporting skills. Tactics and strategies provide the means to place photographic equipment where needed, record photographic images, and then leave the area without leaving behind evidence of having been in the area. Accomplishing that is usually more difficult in rural regions than in the urban environment.

The space of one chapter does not permit a comprehensive treatment of tactics and strategies and neither is that intended. Rather, this chapter emphasizes the importance of tactics and strategies for manual clandestine photography operations. For comprehensive information about tactics and strategies and related topics, consult appropriate military manuals and books on the topic.[1, 2, 3, 4, 5]

1. Hankin, Ron. (2009). *Navigating the legal minefields of private investigations: A career-saving guide for private investigators, detective, and security police.* Flushing, NY: Looseleaf Law Publications, Inc. (www.looseleaflaw.com).
2. Jenkins, Peter. (2010). *Surveillance tradecraft: The professional's guide to surveillance training.* Harrogate, UK: Intel Publishing. (www.intelsecurity.co.uk).
3. Johnson, William R. (2009). *Thwarting enemies at home and abroad: How to be a counterintelligence officer.* Washington, DC: Georgetown University Press. (www.press.georgetown.edu).
4. Ritch, Van. (2003). *Rural surveillance: A cop's guide to gathering evidence in remote areas.* Boulder, CO: Paladin Press. (www.paladin-press.com).
5. Siljander, Raymond and Fredrickson, Darin. (2002). *Fundamentals of physical surveillance: A guide for uniformed and plainclothes personnel,* 2nd edition. Springfield, IL: Charles C Thomas, Publisher, Ltd. (www.ccthomas.com).

Tactics and strategies are important for urban and rural photography operations, but the rural environment presents special challenges, as stated. For that reason, much of this chapter addresses rural photography, although not to the exclusion of the urban environment. Rural tactics and strategies include such disciplines as camouflage and concealment, deception, infiltration, and exfiltration, map reading and navigation, and physical surveillance methods.

OPERATION SECURITY

Keep the Operation a Secret

Never underestimate the importance of operation security. Only people with a need-to-know must be aware of the operation and its location. In an *FBI Law Enforcement Bulletin* article, John T. Nason, Special Agent, Federal Bureau of Investigation, emphasizes the importance of operation security, cautioning that, "Agencies should coordinate planned surveillances on a strict 'need-to-know' basis" (Nason, 2004, May, n.p.).

In his book *Rural Surveillance: A Cop's Guide to Gathering Evidence in Remote Areas,* Van Ritch emphasizes the importance of operation security. Mr. Ritch explains that, "the protection of information regarding the operation is absolutely critical . . . if you have a team member who can't be trusted to keep quiet about an upcoming operation, then you might as well not have that person on the team" (Ritch, 2003, p. 14). While acknowledging the importance of operation security, he cautions that, "security must have the highest priority but don't be so paranoid that you don't get the support you need to ensure your success" (Ritch, 2003, p. 20).

Usually, as security increases, the dissemination of information decreases and the quality of communications diminishes. Predictably, the result is compartmentalized activities and a reduction of operational coordination. Security is important, but operational efficiency is also important; find an appropriate compromise between the two. During planning, clarify mission-specific security needs, devise a plan, and inform all parties during a briefing session.

PRESURVEILLANCE PLANNING AND RECONNAISSANCE

Prior to commencing surveillance, learn everything possible about the subject and their life circumstances. Determine what vehicles they own and drive, and obtain a physical description and recent facial photograph. Dur-

ing reconnaissance, especially in rural areas, consider subject, terrain, and weather.

Clandestine photography teams consist of the surveillance specialist (photographer) and observer. Using a binocular, spotting scope, or image intensifier night vision device, the observer watches the subject and records notes while the specialist concentrates on photographing the subject. In some instances, the team includes a specialist assistant (photo assistant), messenger, and security personnel. The messenger performs such tasks as delivering image cards and reports to a pickup site, in rural areas usually doing that under cover of darkness. The messenger returns with supplies (e.g., fully charged batteries, image cards, water, and food). In some circumstances, for purposes of safety, the messenger must not travel alone.

Manual clandestine photography is a sophisticated tactical operation that begins with planning. Presurveillance planning is essential because to accomplish anything worthwhile, one must first identify his or her objectives. During planning, one clarifies the needs of the case and determines what is required to satisfy those needs. Planning requires acquiring all known information about the subject, associates of the subject, and people in the area of the subject. Planning also requires reconnaissance, a preliminary survey of the area in which the surveillance will occur as well as potential routes leading to and from the surveillance site. Reconnaissance can be by ground, water, air, or a combination of those methods.

Planning is necessary for urban and rural operations, but because rural operations tend to be more challenging, the thrust of this section pertains to rural operations. In his rural surveillance book, Van Ritch provides valuable information about this topic. This chapter addresses only issues that are manual clandestine photography specific. The following summary of important issues is not exhaustive.

- Relative to manual clandestine photography, tactics and strategies are target-specific. In this respect, the photography team infiltrates the area to observe and photograph a specific person, object, activity, or location. At the conclusion of photographing, the team leaves the area (exfiltration) with the subject of surveillance having no knowledge the team was in the area. Sanitizing the vantage point (observation post) before leaving the area is essential; leave no telltale evidence behind to suggest the team was in the area. Should the subject find evidence that somebody was in the area, such as matted foliage, nothing must reveal who was in the area, the duration, or the reason that somebody was there. In some instances, deception has merit with circumstances

suggesting what is appropriate. For example, leaving behind a worn paper folded to fit into a pocket that advertises a bird watchers outing can ally subject suspicion–dates reflected on the paper must be appropriate–put thought into it. The paper may reflect a telephone number and Web address and, if so, create a pretext website and establish a pretext telephone line (trap line). Do the research necessary so that a pretext is believable relative to location and time, and know enough to speak convincingly about the pretext topic if discovered. Here is an excerpt from an Audubon Society website advertisement for fieldtrips: "*Fall migration is well underway!* We have many trips planned this fall and hope they will be well attended. Remember that all trips are held regardless of the weather–although groups and leaders are discouraged from going out during severe storms to look at birds." When considering pretexts, be creative and think from the perspective of those the pretext must deceive. *Caution:* Never base a live pretext on the name of an existing organization.

- The nature of potential vantage points will suggest if they are suitable for daytime photography, nighttime photography, or both.
- Evaluate the feasibility of vantage points relative to the anticipated duration of the operation. A vantage point that is suitable for short-term use may be unsuited for a long-term operation. Similarly, a vantage point may be ideal for nighttime use but not feasible during daylight hours.
- Evaluate potential primary and secondary routes to/from the site.
- Identify potential defensive positions to which the team can retreat if discovered and attacked.
- Consider equipment and supply needs (e.g., cameras and accessories, binocular, spotting scope, communication radios, clothing changes, tent, sleeping bag, sanitary needs, defensive weapons, and food and water).
- Consider support requirements (e.g., photo assistants, messengers, security personnel, and delivery of supplies including food and water).
- Rehearse the operation when necessary. Rehearsal is necessary when encountering an atypical or especially challenging situation, when new and therefore unpracticed methods are required, and when acquiring one or more new team members. Rehearse under conditions approximating the real surveillance site.
- During reconnaissance, especially in rural areas, consider subject, terrain, and weather.
- Check the extended weather forecast. Anticipate how weather will affect photographing and equipment needs and plan accordingly. Err on the side of caution and plan for adverse weather conditions. Be pre-

pared for inclement weather and temperature extremes.

- To maintain continuous visual and photographic coverage of the subject, an extended operation may require a team of six or more people. Based on circumstances and need, a manual clandestine photography team can consist of two surveillance specialists, two observers, two specialist assistants (photo assistants), and a messenger. Some situations require assigning security personnel.
- Safety and security requirements are always important.
- The ability to travel to and from the vantage point without detection determines feasibility.
- Consider vantage point possibilities relative to visual cover to prevent detection by the subject or by somebody who may alert the subject. In many cases, observer to subject distance contributes to cover. People do not expect that somebody will photograph them from distances of 0.80 kilometer (0.50 mile) or more.
- A photography team occupying a difficult to access location is less likely to be discovered and less vulnerable to a rapid reactionary assault should discovery occur.
- Members of a photography team working in rural areas must be wilderness experienced. If they lack wilderness experience, at least one team member must have such experience to include map reading and navigation skills. In some instances, assigning a local person to the team is necessary, somebody who knows the local geography and culture.
- Consider communication needs with equipment redundancy being important. Equipment failure must not cause communication blackout; have backup communication equipment.
- Evaluate observer to subject distance relative to photographic equipment requirements and telephoto capability. Transport an appropriate lens or lenses to the site; magnification must be appropriate for the distance, neither to little or too great. The specialist knows what is photographically possible with existing equipment and has the specialized knowledge to determine what case specific custom photo-optical configurations may be necessary and possible.
- When considering potential vantage points, in addition to the usual criteria such as concealment and unobstructed view, consider elevation and distance. Elevation permits photographing from above near ground thermals (convection currents) and distance provides cover (refer to Figure 7-1 in Chapter 7).
- Determine what optical and electro-optical needs exist for vision enhancement in addition to photographic equipment. For example, will

the observer need a binocular, spotting scope, telescope, an image intensifier night vision device, or a thermal imager? Taking more than one such item into the field often is necessary. To observe the subject the observer may use a spotting scope during daylight hours and use a night vision device at night. He or she may use a thermal imager for security during the day and at night to detect the approach of somebody whether the individuals are innocent hikers or a patrol engaged in countersurveillance.

- When considering equipment needs, determine if specialized equipment is necessary and, if so, is it available? Additionally, does operation of the equipment require specialized expertise? If specialized expertise is required, can a team member acquire the necessary expertise in a timely manner or is assigning somebody with the specialized skill necessary? If a special-skills person is necessary, are they available and at what cost?
- Note the direction of sunlight during various times of the day relative to the location of the subject and potential vantage points. To the extent possible, avoid vantage points that require photographing towards the sun. If that is not possible, select a vantage point that minimizes the duration that photographing towards the sun will be necessary. If the subject has a known routine that information is helpful relative to selecting a vantage point that provides favorable sun direction during the times that photographing is most likely to occur.
- The sun rises in the east and sets in the west. At noon, in the Northern Hemisphere, the sun is due south. At noon, in the Southern Hemisphere, the sun is due north. In the Northern Hemisphere, shadows move clockwise as the day progresses. In the Southern Hemisphere, shadows move counterclockwise as the day progresses. One cannot photograph towards the sun and record quality images. Consider this when evaluating potential vantage points.
- Determine illumination level of the subject area at various times of the day and night. The surveillance specialist determines if, at night, available light photography using a fast telephoto lens and high ISO is possible, or if photographing with an image intensifier night vision device (NVD) is necessary. The specialist also considers if modifying or supplementing artificial nighttime illumination is possible, should that be necessary. For example, do conditions permit installing a hard-wired long-range infrared (IR) illuminator on a nearby building to illuminate the subject area to support ultra long-range night vision photography? This method may require using a "fully covert" IR illuminator that emits no weak red glow detectable by unaided human vision.

- Determine the location of illumination sources and therefore the direction of illumination at various times of the day and night relative to the subject and camera locations.
- When planning for night vision photography, determine the direction of moonlight as it will exist during various times of the night relative to the location of the subject and each potential vantage point. Know the time of moonrise and moonset, moon location, and moon phase for each night of anticipated surveillance. Identify sources of artificial illumination in the area of the subject and determine the energy distribution of the bulbs relative to the spectral response of the night vision device. Often, it is easiest to record some presurveillance night vision images and scrutinize results. When possible, keep it simple!
- Think of moonlight as low-intensity sunlight in terms of how it behaves such as direction of illumination, what it illuminates, highlight and shadow areas, the shadows it casts, and the silhouettes it creates. Will the subject be front, side, or backlit? The intensity of moonlight varies considerably by lunar phase and other variables (refer ahead to Figure 6-14). Chapter 5, subheading *Moonlight,* provides useful information.
- Many things determine the feasibility of a vantage point depending on case specific needs. However, the one thing that must always exist is concealment and an unobstructed view of the subject. The surveillance specialist must have a clear view of the subject but the subject must not have a clear view of the vantage point (see Figure 6-1). A position in the shadows beyond a tree line providing a view between trees and foliage accomplishes this. The subject sees only trees and foliage. Travel to and from the vantage point from a direction opposite the subject.

During the daytime preliminary survey (reconnaissance) in preparation for daytime or nighttime photography, record overview and telephoto images of the subject area from each potential vantage point. If necessary, record a panoramic overview of the subject area. Recording such images documents the scene and confirms the degree of magnification necessary to record detail such as recognizable images of people and legible vehicle number plates (license plates).

During planning for nighttime clandestine photography, conduct both a daytime and nighttime preliminary survey. The nighttime survey is necessary because that is the only way to know with certainty what the nighttime conditions are at the vantage point and subject locations.

Figure 6-1. Initially, the vantage point from which the surveillance specialist recorded this image appeared suitable although it is not. The electrical line running horizontally through the scene is a visual obstruction. With unaided vision, the electrical line passing through the scene was not apparent, but its presence was evident when examining the scene using an 8x binocular. Even with a binocular, however, the seriousness of the obstruction was not apparent. It was only after recording test exposures using the intended optical system that the seriousness of the obstruction became apparent. This image illustrates the importance of using magnification to scrutinize the subject location from potential vantage points. It also illustrates the importance of recording pre-surveillance test exposures in some instances. Sometimes, but not always, the specialist can reposition photographic equipment at the vantage point to eliminate visual obstructions from the field-of-view. The specialist recorded this image from 0.97 kilometer (0.60 mile). *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope and 1.4x tele-converter. *Effective focal length and f-ratio:* 3290mm f/14. *Method:* Direct coupling (prime focus).

CAMOUFLAGE AND CONCEALMENT

> In covert surveillance situations, illumination of the photographer by the LCD screen may compromise safety. (*Forensic Science Communications, Vol. 4,* Number 2, 2002, April, n.p., *Surveillance Photography SOP.*)

Remember the principles of camouflage. The things that capture the subject's attention are shape, shine, shadow, silhouette, surface, and movement. The purpose of camouflage and concealment in the rural environment is to prevent detection. *Camouflage* permits blending with the environment while *concealment* hides personnel and equipment from view. Camouflage and concealment usually work together.

Human camouflage consists of camouflage clothing, Ghillie suits, and camouflage face paint. Near infrared (NIR) compliant clothing is useful in certain environments. Equipment camouflage consists of nonreflective paint of appropriate color and pattern, camouflage fabric, Ghillie blankets, Ghillie rifle wraps, camouflage netting, and NIR compliant netting in some environments.

Camouflage can be manufactured or natural with both often used together. Camouflage obscures a person and equipment by eliminating recognition factors. Recognition factors that can betray the presence of a photography team and their equipment includes the following:

- Shape
- Silhouette
- Shine/reflectance
- Surface/texture
- Patterns
- Color
- Shadow
- Movement
- Smell
- Sound
- Light (visible and near infrared)

When contemplating the recognition factors identified above, consider them relative to the five categories of target indicators listed below. Target indicators are the things that suggest human presence. Each of the five items is important, but movement tops the list because nothing betrays human presence quicker than movement. The five target indicators are:

- Movement
- Sound
- Disturbance of wildlife
- Improper use of camouflage
- Odors

When selecting camouflage clothing, do not overlook padded kneepads and elbow pads. They are necessary when crawling and when photographing from a kneeling or prone position. For ease of operating the camera, to feel the controls, consider wearing camouflage fingerless sniper gloves, or cut a portion of the fingers from a preferred glove.

The following images illustrate various applications of camouflage and concealment for people and equipment in various rural environments as it pertains to manual clandestine photography (see Figures 6-2 to 6-12).

> Observation in northern areas requires a number of special considerations. Observers must contend with extended light in summer and extended darkness in winter, along with the cold, snow, ice, fog, rain, and sleet. . . . Shelter is critical for protection of the men and their equipment from the elements. When using northern sites, observers must take advantage of wind breaks,

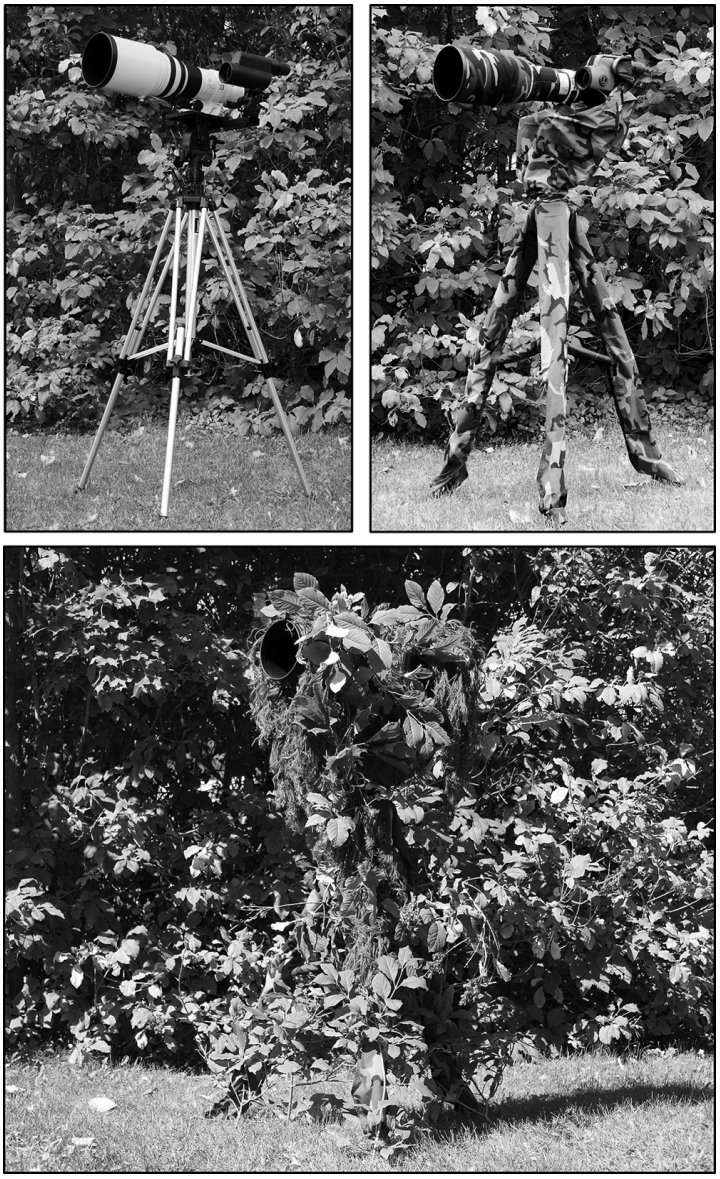

Figure 6-2. There are varied degrees of camouflage. In the lower image, Ghillie rifle wraps and twigs bearing leaves supplement the fabric camouflage applied to the camera, lens, and tripod. The surveillance specialist looking through the camera in the lower image is wearing a Chameleon Ghillie suit. In practice, the specialist photographs from beyond the tree line so that natural foliage adds to the camouflage and provides a degree of concealment. That is an example of camouflage and concealment working together. Observe the straight edge of the lens shade apparent in each image. The straight edge is a recognition factor that can disclose the photography team's presence in spite of otherwise quality camouflage. Photos by Richard Trombley.

Figure 6-3. There are no straight lines in nature and therefore the front edge of a conventional lens shade serves as a recognition factor. The camouflage-pattern lens shade extension eliminates that recognition factor. Making a lens shade extension in-house is necessary because nobody sells such a product. The surveillance specialist made this lens shade extension using the plastic from one-gallon white vinegar jugs and covering it with camouflage cloth matching the Forest Green LensCoat lens cover. The Wimberley Head Version II supports the Canon EOS 5D full-frame digital single-lens reflex (DSLR) camera and Canon EF 600mm f/4L IS USM telephoto lens.

Figure 6-4. The surveillance specialist is wearing a Ghillie suit and camouflage gloves. The Canon EF 300mm f/2.8L IS USM telephoto lens sports a camouflage lens shade extension to eliminate the telltale straight line of the conventional lens shade. In the upper image, camouflage is incomplete without the Ghillie Rifle Wrap to conceal the telephoto lens as shown in the lower image. Alternatively, instead of a Ghillie Rifle Wrap, the specialist could have applied a camouflage LensCoat lens cover to the telephoto lens. These comparative images illustrate that camouflage must be complete to be effective.

> such as densely wooded areas, downwind sides of terrain elevations, and depressions. (Department of the Army, FM 31-20-5, 1993, March 23, pp. A-7 to A-8, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*)

The previous illustrations leave it apparent that camouflage must be appropriate for the environment, must be complete to be effective, and they illustrate that camouflage and concealment usually work together. Camouflage obscures things by eliminating recognition factors. Concealment fully or partially hides things from view.

Figure 6-5. The Ghillie suit and Ghillie blanket provide good camouflage, but the Canon EF 600mm f/4L IS USM telephoto lens in the upper image serves as a recognition factor. The Ghillie rifle wrap applied to the lens in the lower image makes the camouflage more effective. The surveillance specialist is using the camera mirror lock-up feature and operating the camera using a remote release while observing the subject using the Leupold Mark 4 12-40x60 Tactical Spotting Scope sporting an antireflection device (ARD). The Celestron mini-geared head supporting the spotting scope permits precise alignment of the two optical systems.

Planning for the safety of the photography team is important because they are vulnerable to surprise attack, especially when working from a blind. Additionally, the team is too few in numbers to defend against a well-armed assault and neither can they sustain a prolonged firefight even after retreating to a defensive position.

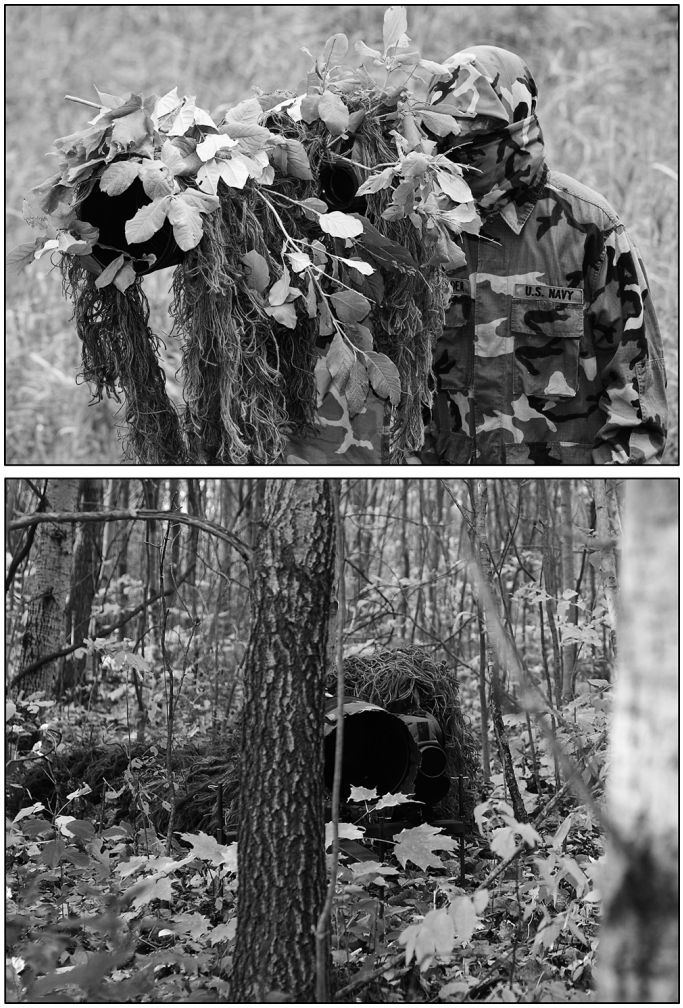

Figure 6-6. Be creative when applying camouflage. *Upper image:* A Shemagh covers the surveillance specialist's head. Two Ghillie rifle wraps and supplemental foliage conceals the digital single-lens reflex camera, Canon EF 600mm f/4L IS USM telephoto lens, and the Leupold Mark 4 12-40x60 Tactical Spotting Scope. The specialist is using the camera's mirror lock-up feature and operating the camera using a remote shutter release while observing the subject through the spotting scope. *Lower image:* This surveillance specialist, wearing a Ghillie suit and covered by a Ghillie blanket, is using the camera mirror-lockup feature and operating the camera using a remote shutter release while observing the subject through the Leupold spotting scope. The spotting scope features an antireflection device (ARD). The irregular-edge camouflage lens shade extension on the Canon 600mm f/4 telephoto lens leaves visual detection less likely. Be aware, however, that the dark round spot represented by the front of the telephoto lens can appear unnatural against the background and thereby serve as a recognition factor. When viewed from the front, the irregular edge of the lens shade extension is less apparent and less effective. In the upper image, the specialist used leaves in an effort to minimize this effect.

Figure 6-7. Antireflection devices (ARDs) are often necessary to prevent light reflection from optical surfaces revealing the presence of the photography team. Located within a blind and using ARDs, the team is not visible from the subject location. Be aware, however, that the dark somewhat horizontal opening in the foliage can serve as a recognition factor. Minimize the size of the opening as much as possible. In some instances, two small openings are necessary, one opening serving the surveillance specialist and the other opening serving the observer. Always replace supplemental foliage before it changes color and becomes a recognition factor.

Figure 6-8. The surveillance specialist, wearing a Ghillie suit, is standing in the upper image and crouched in the lower image. By crouching, the specialist takes advantage of both camouflage and concealment. Being motionless is essential. When transitioning between a standing and crouched position, move slowly, move slow enough that the human eye will not detect movement.

Near Infrared (NIR) Compliant Clothing

(Near Infrared (NIR) Signature Management Technology)

Near-infrared (NIR) Signature Management Technology is used by the U.S. Department of Defense to prevent detection by NIR Image Converters. These photocathode devices do not detect temperatures, but rather infrared radiation variances. NIR-compliant uniforms use a special fabric that allows

Figure 6-9. Camouflage and concealment work together in most instances even though concealment is often partial, not complete. Foliage conceals a large portion of the Klepper Commando II 545 Military Folding kayak leaving detection unlikely by somebody viewing the area from a distance using unaided vision. Both occupants, wearing camouflage clothing, positioned themselves so that vegetation obscures the telltale outline of the human form. In some instances, adding foliage to the kayak is desirable. In the absence of a breach of the principles of camouflage and concealment such as light reflection and movement, detection of this clandestine photography team is unlikely. When the kayak is at rest, stow the paddle or turn the blades so the subject cannot see the flat surface, doing that to make the blades as invisible as possible. In the upper image, the paddle position is deliberately incorrect to illustrate the importance of minimizing paddle visibility. Do everything possible to be as invisible as possible–and be very still, executing necessary movement slowly.

> soldiers to appear at the same radiation level as the surrounding terrain, thus making them more difficult to detect. NIR technology also make uniforms less visible in low-light environments by reducing the reflection of light. (Propper Ecommerce, Inc., 2009, n.p., *Near-infrared Technology*)

Figure 6-10. Portable hunting blinds, when their use is appropriate, provide shelter from the elements, which increases comfort and provides protection for photographic equipment. During winter, when circumstances permit, use a propane tent heater for comfort and to prevent hypothermia; one is motionless in the blind. Heating the blind also keeps photographic equipment warm enough for reliable operation and it prevents dew formation on the equipment. If not using a tent heater, use the Astrozap® Dew Controller system or use air activated hand warmers to keep the camera and lens warm enough for reliable operation and to prevent dew formation on equipment surfaces (refer to Chapter 7, subheading *Heated Dew Shields and Heat Bands*). The white blind is located in the center of the upper image. Somebody can pass surprisingly close to a camouflage blind without noticing it. Use concealment when traveling to and from the blind by keeping it between oneself and the subject. Enter and exit the blind from the backside having positioned it appropriately during setup as illustrated in the lower right image. Leonard Rue Enterprises, Inc., markets the Rue Ultimate Photo Blind, which is reminiscent of a portable hunting blind but configured specifically for photography (www.rue.com). Unfortunately, the Rue Ultimate Photo Blind features only two camouflage options, brown and green, no white.

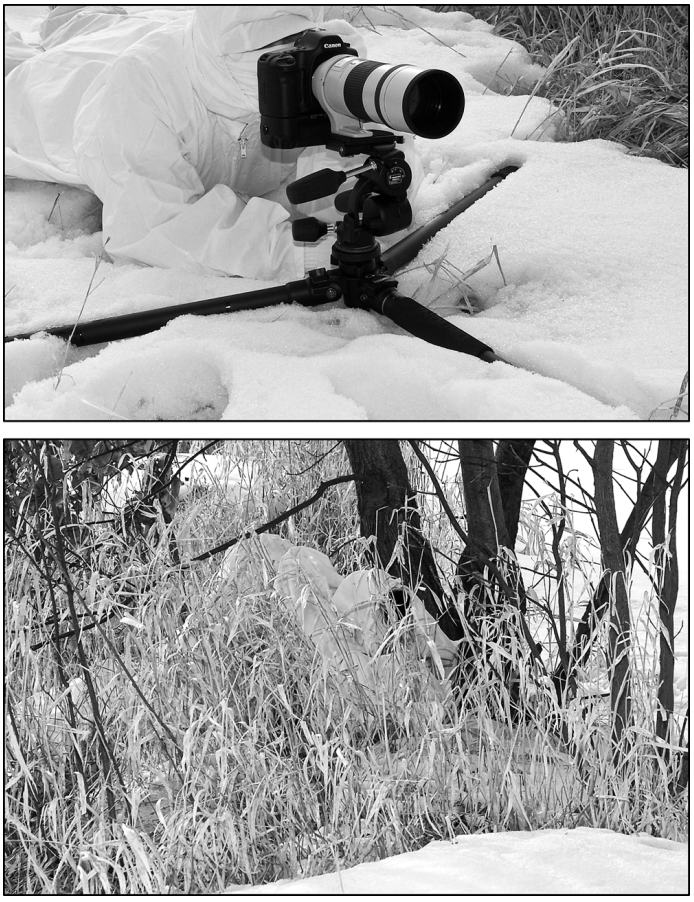

Figure 6-11. Camouflage is just as important during winter months (and in Arctic regions) as it is during summer months. The upper image shows the importance of camouflaging equipment and it illustrates the importance of camouflage being complete. Incomplete camouflage is ineffectual (refer back to Figure 6-4). In this instance, a white Ghillie Rifle Wrap would serve well to conceal the camera and tripod. In the lower image, the white cloth contributes to a brighter viewfinder image and it features camouflage value. Unfortunately, this method leaves the specialist vulnerable to a surprise attack. The nearby observer must be vigilant.

In many instances, wearing near infrared (NIR) compliant clothing provides an advantage by blending better with foliage when viewed by somebody using an image intensifier night vision device, which operates on the principal of light intensification (light amplification). Like most things, NIR-compliant clothing provides benefit when properly used in an environment for which it was designed, but it is not suitable in all instances (see Figures 6-13 and 6-14).

Figure 6-12. The surveillance specialist is wearing a white military camouflage suit with a white Shemagh on his head. In the upper image, the specialist is using the crotch of a tree branch as a field expedient lens support. The lower image illustrates that only a few branches in the foreground are required to disrupt a subject's view of the specialist. The tree branches visually disrupt the telltale outline of the human form.

Near infrared (NIR) compliant clothing serves well when worn among foliage as intended, but it can be a liability in other environments such as on open water. As Cyrus Smith reports (2001, September, p. 61), "the standard BDU, currently designed to match a foliage background with a reflectivity

Figure 6-13. Night vision image. The surveillance specialist recorded this image using a camera-adapted image intensifier night vision device. Supplemental illumination provided by an infrared (IR) illuminator. The subject on the left wears near infrared (NIR) compliant camouflage clothing, but his Boonie hat is non-NIR compliant. Observe the difference in the reflective characteristics of his clothing versus his Boonie hat. The subject in the center and the subject on the right are wearing non-NIR compliant camouflage clothing–note the reflective difference between the two. The center subject is wearing camouflage face paint. The subject on the left and the right wear no camouflage face paint. *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Night vision device:* Standard AstroScope Night Vision Module, Gen 3 (third generation). *Lens:* Canon EF 200mm f/2.8L II USM telephoto lens. *ISO:* 200. *Aperture:* f/2.8. *Exposure time:* 1/13th second. The camera was tripod mounted.

spectrally similar to chlorophyll, makes a very poor match to a sea background" (see Figure 6-15).

The previous illustrations verify the importance of using an image intensifier night vision device to evaluate the near infrared (NIR) reflective characteristic of clothing relative to the environment before embarking on a nighttime mission. Do this prior to an inland (ground) operation and prior to a maritime (water) mission. For inland missions, repeat the evaluation with each season change. Seasonal evaluations are important because when summer yields to fall, the amount of chlorophyll in foliage decreases. When chlorophyll decreases, the spectral reflectivity of foliage undergoes a change. If the possibility exists that a subject uses an image intensifier night vision device for countersurveillance, it is important to select clothing most likely to thwart detection efforts.

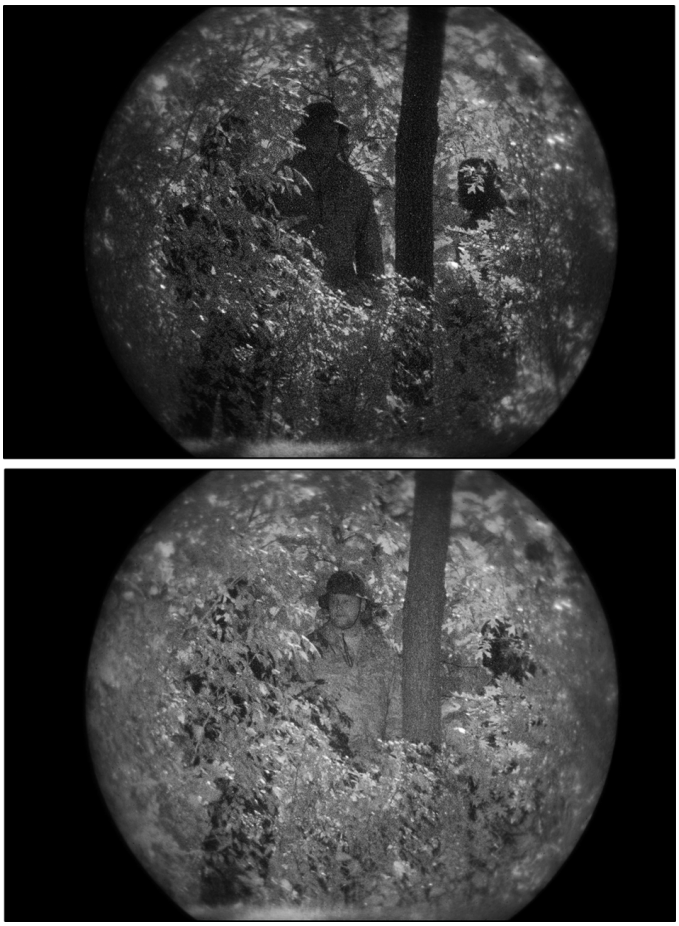

Figure 6-14. Night vision images. The surveillance specialist recorded these night vision images with and without supplemental infrared (IR) illumination to demonstrate the effectiveness and shortcomings of near infrared (NIR) compliant BDUs and non-NIR compliant BDUs. *Upper image:* Night vision image recorded without supplemental infrared (IR) illumination. Starlight and a 92 percent moon provided illumination. The center subject wears near infrared (NIR) compliant camouflage BDUs with a non-NIR compliant Boonie hat. It is clear that NIR-compliant clothing provides little advantage over non-NIR compliant clothing when backlit, backlit by the moon in this instance. The distinctive human shape is apparent and his BDUs blend poorly with the foliage. *Lower image:* Night vision image recorded with supplemental infrared (IR) illumination provided by an infrared (IR) illuminator. This is the same scene as above with all things being equal except for the supplemental infrared (IR) illumination. Observe that the center subject wearing near infrared (NIR) compliant camouflage BDUs blends well with the foliage but his non-NIR compliant Boonie hat contrasts with the foliage. That is another example verifying that camouflage must be proper and complete to be effective. The presence of the other two subjects is apparent because they wear non-NIR compliant BDUs. Wearing a non-NIR compliant Boonie hat with NIR-compliant BDUs is for illustration purposes only.

Figure 6-15. Night vision image. These subjects are using the Klepper Commando II 545 Military Folding Kayak featuring the camouflage deck. The forward occupant, the surveillance specialist (photographer), is wearing an NIR-compliant Boonie hat but non-NIR compliant BDUs. The rear occupant, the individual paddling, is wearing a non-NIR compliant Boonie hat and BDUs. Observe that although both individuals are wearing non-NIR compliant BDUs, the near infrared (NIR) reflective characteristics of each are conspicuously different. Presenting this mixture of NIR-compliant versus non-NIR compliant garments is for illustration purposes, for educational purposes. Avoid wearing NIR-compliant BDUs for waterborne operations because they appear too light against the water. The front occupant of the kayak is using a digital single-lens reflex camera with the AstroScope Night Vision Module.

Note: Using a camera adapted NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device (NVD), the surveillance specialist recorded the previous night vision image under exceedingly difficult circumstances. He recorded the image without an infrared (IR) illuminator in spite of the fact that there was no moon and only some stars showing through the partially overcast sky. Light fog permeated the area. The specialist handheld the camera while photographing from a moving platform (pontoon boat), and the kayak and occupants were in motion. Using the Kenyon KS-8 gyrostabilizer made handholding the camera possible under the difficult circumstances. The low level of ambient nighttime illumination resulted in a slow shutter speed (1/25 second) and increased NVD gain. Increased gain reduced image resolution. Additionally, using ISO 400 increased noise, which reduced image resolution. The specialist in the kayak, forward position, is using a gyrostabilized DSLR camera with a Gen 3 AstroScope Night Vision Module fitted with a short telephoto lens.

PREVENTING LIGHT REFLECTION FROM EYEGLASS LENSES

> SEALs are required to perform a variety of tasks that require a high vision aptitude. SEAL candidates may qualify for PRK Refractive Surgery to correct their vision. (Naval Special Warfare Command, n.d., n.p., *Vision requirements*)

For the surveillance specialist, having to wear eyeglasses is sometimes problematic. Eyeglasses are susceptible to breakage and loss, they make seeing difficult when they get wet or fog up, and they can diminish viewing efficiency when using a camera, binocular, spotting scope, telescope, image intensifier night vision device, or laser rangefinder.

In addition to the above concerns, light reflecting from eyeglass lenses can reveal the presence and location of a clandestine photography team. This concern is greater in rural areas than in the urban environment. Some possibilities to minimize light reflection from eyeglasses include, but are not limited to, the following.

- When purchasing eyeglasses, select the best antireflective (antiglare) coating available. Antireflective coating does not prevent light reflection from the lens surface, but it does reduce it. Additionally, antireflective coating enhances vision. In their discourse *Eye changes with aging,* the University of Illinois Eye & Ear Infirmary (2009, May 19, n.p.) explains that, "To maximize the light entering the eye, make sure that your eye glasses have anti-reflective coating. Anti-reflective lens coatings significantly reduce surface reflectance and allow greater light transmission through the lens." Own two pairs of eyeglasses, one pair for normal daily use and the other reserved for clandestine operations. In the field, always have a backup pair of eyeglasses because loss and breakage can occur. Keep the backup eyeglasses in a hard clamshell case for protection.
- For clandestine use, select dark dull finish frames.
- Select eyeglasses with small diameter lenses; they reflect less light.
- Cover the eyeglass lenses with nylon material from a pair of women's brown or black hose (stockings or pantyhose). While this is effective, visibility is somewhat impaired.
- Cover the eyeglass lenses with a nonreflective material featuring a narrow horizontal slit so that the glasses function in a manner reminiscent of the snow goggles worn by the Inuit and Sámi peoples of the Arctic regions to prevent snow blindness. So configured, there is little glass

surface to reflect light. Experiment with the width of the slit but keep it as narrow as visibility requirements permit, perhaps no wider than 3.175 millimeters (1/8 inch). Black dull finish gaffer tape will leave no sticky residue when removed from the lenses, although the authors have not experimented to determine if the adhesive will damage the lens coating. Experiment with inexpensive glasses to make this determination or obtain eyeglasses solely for this purpose and leave the tape permanently in place.

- When wearing eyeglasses also wear a camouflage Boonie hat with the brim positioned low over the lenses to minimize light reflection.
- Work from the shadows–use shade to prevent direct sunlight, moonlight, and starlight striking the lenses.
- When looking in the subject's direction, position the head in a manner that prevents light reflected from the eyeglass lenses shining in the subject's direction. Do not permit the lenses to act as a signal mirror.
- A camouflage face veil will prevent or at least minimize light reflection from eyeglass lenses.
- Consider using extended wear contact lenses and carry an extra set. Additionally, carry appropriate lens cleaning materials and Handi Wipes (sanitizing wipes) to clean the hands. Cleaning contact lenses or inserting a lens into the eye is problematic when the hands are dirty.
- Contact lenses are useful during inclement weather; wet eyeglass lenses impair visibility.
- Investigate the appropriateness of laser eye surgery to eliminate the need to wear eyeglasses. Obtain competent medical advice regarding this possibility. When appropriate, the United States military provides such surgery for special operations forces personnel.

INFILTRATION AND EXFILTRATION

Travel to and from the Photographic Vantage Point

> A mission becomes infeasible when all potential infiltration and/or exfiltration methods are infeasible. If you can't get there, the mission is infeasible! (Department of the Army, FM 31-20-5, 1993, March 23, p. 2-10, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*)

Infiltration and exfiltration is simply traveling to and from the photographic vantage point unseen, and without leaving evidence of the commute having occurred. Travel occurs by land, water, or air, or a combination of

those methods, with circumstances determining the most suitable methods. This discussion does not address infiltration and exfiltration by air. Land and water methods of travel include, but are not limited to, the following:

- Foot, skis, or snowshoe
- Pack animal
- Four-wheel-drive vehicle such as a Jeep or pickup truck
- All-Terrain vehicle (ATV)
- Snowmobile
- Powerboat or pontoon
- Personal watercraft (PWC) such as Jet Ski or Sea-Doo
- Inflatable boat–many models exist
- Kayak–military or civilian model

Tactics and strategies are essential to all manual clandestine photography operations with infiltration and exfiltration in rural areas being especially challenging. Infiltrating a rural area and remaining undetected while at the vantage point (observation post) for an extended time is difficult. Leaving the area undetected is also challenging. Moreover, the team must leave nothing behind to reveal that somebody was in the area. Accomplishing all that requires a high level of expertise and diligence.

The United States Army manual FM 31-20-5 (1993, March 23, p. 3-22), *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces,* confirms the challenge of rural operations. An excerpt from the manual reports that, "A key to mission success during SR [Special Reconnaissance] is the ability to infiltrate the target area, gain all available information, then exfiltrate while the threat remains unaware of the SFOD's [Special Forces Operational Detachments] presence." In the rural environment, evidence for which countersurveillance personnel are alert includes, but is not limited to, discarded rubbish, footprints, trampled foliage, and broken bush and tree limbs.

Whether the means exists to infiltrate and exfiltrate without detection can determine the feasibility of a mission. The above quoted manual also reports that, "A mission becomes infeasible when all potential infiltration and/or exfiltration methods are infeasible. If you can't get there, the mission is infeasible!" (FM 31-20-05, 1993, March 23, p. 2–10).

During infiltration and exfiltration, somebody must be responsible for rear security to detect anybody endeavoring to follow the photography team. While on site, one or more people are responsible for security to prevent a surprise attack. This is important because the surveillance specialist and observer are engrossed in the task of observing and photographing the subject and therefore they are vulnerable. The following example illustrates the importance of assigning security personnel for some operations. To relieve a surveillance specialist at midnight, one of the authors traveled by foot

Figure 6-16. Night vision image. Infiltration requires stealth, the ability to travel without detection in an active countersurveillance environment. This individual, one of two people in the Klepper Commando II 545 Military Folding Kayak, is wearing an image intensifier night vision device (NVD) supported by a head mount assembly. The NVD enables him to see to navigate. His BDU is non-NIR compliant, which is preferred for waterborne operations; NIR-compliant BDUs appear too light against dark water. Handholding the camera and gyrostabilizer assembly a surveillance specialist recorded this night vision image under difficult conditions–no moon and only partial stars showing through an overcast sky. Moreover, he was photographing while standing on a moving watercraft.

through a cornfield to the vantage point. Upon reaching the vantage point, without detection he got within approximately 3 meters (10 feet) of the specialist who was concentrating on the subject area.

Sometimes, during rural infiltration, the clandestine photography team begins with one transport method and then transitions to another. For example, a land vehicle pulling a trailer may transport the team and a partially assembled kayak to a shoreline location. From there a powerboat transports the team and kayak to a forward position. From there, travel is by kayak. The kayak destination may be the final destination or the team may dismantle and conceal the kayak and travel the remaining distance by foot.

Security concerns often require nighttime infiltration and exfiltration using darkness as cover. When that occurs, travel may require use of image intensifier night vision devices (see Figure 6-16).

When using an image intensifier NVD, the green phosphor screen image eliminates the observer's dark adaptation. For that reason, one must consider the importance of retaining dark adaptation when deciding whether to use

a monocular, biocular, or binocular NVD. When using a night vision binocular or biocular, the observer enjoys the benefit of viewing with both eyes, but that leaves them without dark adaptation. Losing dark adaptation can be a problem should unaided nighttime vision become necessary. When using a night vision monocular, only the eye used for making observations loses dark adaptation with the other eye remaining dark-adapted. That can be a lifesaver in some instances. When using a night vision monocular for direct viewing, consider using the nondominant eye. That will leave the dominant eye dark-adapted.

A rainy night provides good cover for infiltration and exfiltration. That is because people tend to be indoors, rain diminishes a subject's visual countersurveillance capability, rain masks sound, wet ground tends to be quiet to walk upon, and rain can wash away footprints. Realize, however, that a flash of lightning can result in discovery if one is in an open area when the flash occurs.

When circumstances permit, infiltrate by one route and exfiltrate by a different route. Do that in case somebody observed the team during infiltration or discovered evidence of their passage. Leaving by a different route minimizes the potential for a surprise attack.

KLEPPER COMMANDO II *545* MILITARY FOLDING KAYAK

> One of the most stealthy boats around, kayaks allow SF [Special Forces] Soldiers to paddle unnoticed in rivers and lakes. (United States Army, 2009, n.p., *Special Forces, Equipment: Kayaks*)

Clandestine photography teams sometimes photograph from a kayak. Additionally, kayaks serve well for day and night reconnaissance, surveillance of waterfront properties and activities, infiltration and exfiltration, equipment transport, and resupply.

In some instances, the only possible photographic vantage point is from the water. In other instances, although other vantage point possibilities exist, working from a camouflaged kayak enables the surveillance specialist to occupy a more favorable location or occupy an unexpected location that a subject is unlikely to scrutinize. The unexpected location can be a section of coastline along inhospitable terrain, or it can be a swamp that powered watercraft other than airboats cannot negotiate. Occupying waters inaccessible to conventional powerboats also minimizes the likelihood of accidental or deliberate discovery and it can aid in escape and evasion.

The Klepper Commando II 545 Military Folding Kayak[6] is portable, reliable, stable, stealthy, fast, maneuverable, and it features very little hull slap. Its limited draft permits navigating shallow waters and its low signature results in being less conspicuous and casting less shadow than most types of watercraft; the occupants sit below the waterline. Moreover, it is easy to transport the kayak on a secondary watercraft to a forward position, easy to portage, and it is easy to dismantle and hide (cache) subsequent to infiltration. This kayak is a durable and long-lasting vessel designed specifically for clandestine applications (see Figures 6-17 and 6-18).

At night, darkness and distance provides cover. Nevertheless, moonlight can leave watercraft visually detectable from shore if the subject is in a darkened area scrutinizing the waters with dark-adapted eyes. Conversely, a subject in an area featuring artificial illumination is unlikely to see the kayak. If the subject uses a night vision device for countersurveillance, countermeasures require consideration. Backlighting, whether by sunlight or moonlight, results in a silhouette that leaves the kayak and occupants more susceptible to visual detection (see Figure 6-19).

The military special operations forces of many countries use folding kayaks for covert and clandestine operations with the Klepper Commando II 545 Military Folding Kayak, featured here, being preferred. For quality and performance, this handcrafted kayak is unsurpassed. Klepper Faltbootwerft AG, located in Rosenheim, Germany, began manufacturing kayaks during the year 1909.[7]

The low profile of the Klepper military kayak, its subdued earth tone coloring (camouflage, olive, or black), its nonreflective finish, and camouflaged occupants sitting below the water line leaves it difficult to see. That contributes to its stealth capabilities, but it also leaves it vulnerable because powerboat operators are unlikely to see it. Plan and travel accordingly.

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6. Klepper America, Santa Ana, California, USA–www.klepperamerica.com. Klepper Faltbootwerft AG, Rosenheim, Germany–www.klepper.com.

7. When purchasing a Klepper kayak, verify that it is a genuine Klepper. Klepper has learned that in the United States and Japan, new counterfeit Klepper Folding Kayaks and supposed "recycled" Klepper kayaks are appearing on the market. Klepper offers no recycled kayaks and their new (authentic) kayaks are manufactured by Klepper Faltbootwerft AG in Rosenheim, Germany. Moreover, Klepper Faltbootwerft AG furnishes an identification number for all their kayaks, the number being necessary to benefit from Klepper's worldwide product warranty.

Figure 6-17. With both people paddling, the hand crafted Klepper Commando II 545 Military Folding Kayak can travel at a sustained speed of 8 kilometers per hour (5 miles per hour / 4.34 knots per hour) covering a distance of 48.28 kilometers (30 miles) a day. The Klepper military kayak illustrated here features the carbon fiber frame, which results in a lighter weight craft. Three packing/carrying bags contain this kayak when dismantled. An experienced team can assemble this kayak in as little as 15-20 minutes. Observe in the lower image that the surveillance specialist's left hand supports a Kenyon KS-8 gyrostabilizer, which in turn supports the camera and lens. In addition to the gyrostabilizer, the lens' image stabilization feature is active.

CIVILIAN KAYAKS

Clandestine photographers working in the rural environment should be as creative and resolute as wildlife photographers are.

Wildlife photographers are a good source of information about telephoto photography in wilderness areas. Wildlife photographer John Van Den

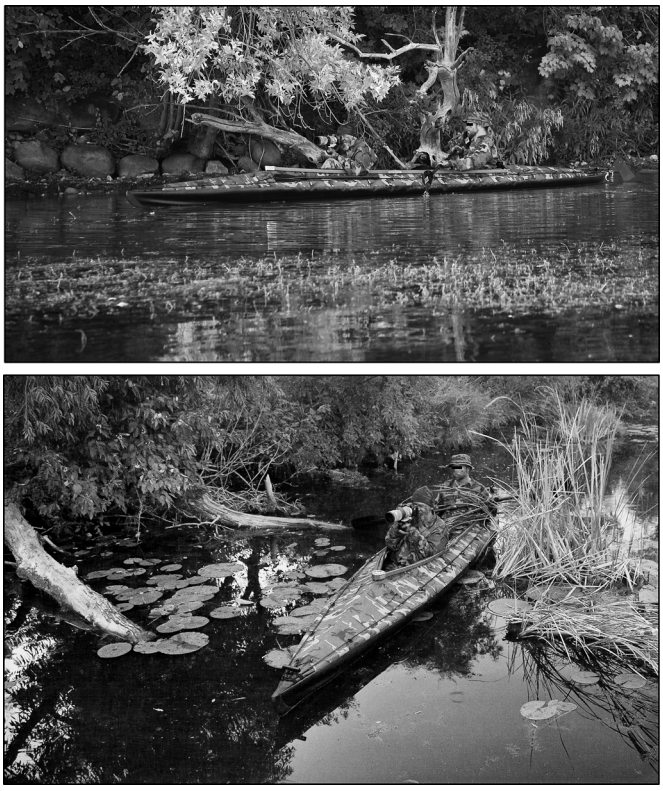

Figure 6-18. The Klepper Commando II 545 Military Folding Kayak provides a stable photography platform whether in motion or sitting at rest along the shoreline. The camouflage deck of the kayak enables it to blend with the coastline. The more varied (visually cluttered) the background, the better the kayak escapes visual detection. The kayak deck is available in camouflage, olive, and black. United States military forces favor the black deck, which is the most universal. Navigating close to shore is possible because this kayak, when loaded to capacity, requires only 21 centimeters (9 inches) of water. The kayak illustrated here is empty except for the occupants. In the upper image, the kayak is at rest in an estimated 15.24–20.32 centimeters (6–8 inches) of water.

Brandt of Wild Wind Images[8] photographs from the Ultimate™ 12 kayak. He selected this kayak for its maneuverability and stability (see Figures 6-20 and 6-21). People using the Ultimate 12 for fishing commonly stand in it, attesting to its stability. Native Watercraft, located in Greensboro, North Carolina (USA), manufactures this kayak. Available colors include olive, which makes it suitable for clandestine applications.

8. Wild Wind Images, John Van Den Brandt. Website: www.wildwindimages.com. Be sure to view the video!

Figure 6-19. Although stealthy, the Klepper Commando II 545 Military Folding Kayak is detectable when backlit by the sun during the day or by the moon at night. Detection is likely by a subject using large aperture binoculars or an image intensifier night vision device (NVD). Light reflection from the water creates a silhouette, whether from the sun, moon, or stars. Cyrus M. Smith (2001, September, p. 61) explains that, "a true back-lit case, with the boat seen as a silhouette, is very easily seen." During travel, avoid being backlit.

Figure 6-20. Wildlife photographer John Van Den Brandt is wearing a Ghillie suit and photographing from the Ultimate 12 kayak. He is using a tripod mounted Canon digital single-lens reflex camera and Canon EF 500mm f/4L IS USM super telephoto lens camouflaged by a LensCoat lens cover featuring the Realtree camouflage pattern. When photographing people, use a black tripod and consider also applying LegCoat tripod leg covers (refer to Figure 7-11 in Chapter 7). He stated that the stability of this kayak makes it an ideal platform for waterborne photography but only from calm waters. He explained that, "I only shoot on the water on calm days because otherwise a subject viewed in my big lens bobs up and down on even light ripples" (John Van Den Brandt, personal communication, August 3, 2009). Image courtesy of John Van Den Brandt/Wild Wind Images.

When using a kayak or inflatable boat, dress for the weather and consider survival in the event the craft capsizes. During cold weather, and when water temperature is low, kayakers wear wetsuits or dry suits. Consider also the suitability of wearing a survival (immersion) suit. Research the topic because making an informed decision requires having adequate information.

Figure 6-21. In the upper image, wildlife photographer John Van Den Brandt is wearing a Ghillie suit and photographing from his camouflaged Ultimate 12 kayak. Observe that he applied an irregular-edge lens shade extension to eliminate the telltale uniform line of the lens shade. He is using a tripod-mounted Canon digital single-lens reflex camera and the Canon EF 500mm f/4L IS USM super telephoto lens camouflaged by a LensCoat lens cover featuring the Realtree camouflage pattern. In the lower image, he is photographing from the ingenious kayak blind he invented. For manual clandestine photography involving human subjects, adding some reeds to the craft would render it near invisible in this setting. In many instances, supplemental foliage is unnecessary, especially when distance provides cover and/or other visual obstructions exist. Images courtesy of John Van Den Brandt/Wild Wind Images.

Failure to research the topic can result in making inappropriate equipment selections. For example, not all wetsuits are suitable for kayaking (e.g., wetsuits for diving and those designed for windsurfing lack the shoulder flexibility necessary for paddling).

Figure 6-22. Small inflatable boats are useful for many waterborne tasks because they are stable and quiet during use, easily hidden among foliage once deflated, and reinflating them in the field is easy using a foot pump or battery-powered electric pump. The surveillance specialist is photographing from an inflatable boat measuring 365.76 centimeters (12 feet) in length and 152.4 centimeters (5 feet) wide. Although weighing only 21.77 kilograms (48 pounds), this boat features a load capacity of 544.31 kilograms (1,200 pounds). Maximum outboard motor power rating is 2.5 horsepower. This boat sports the camouflage boat boot, without which it would be too conspicuous for clandestine use. If a camouflage boat boot is unavailable for the desired craft, contract with an upholsterer to make one.

INFLATABLE BOATS

Small inflatable boats are inexpensive, lightweight, quiet, stable, and easy to deflate and conceal (cache) following infiltration.

Small inflatable boats are useful for infiltration and exfiltration, coastal reconnaissance, waterborne photography, river and lake crossings, and for use as a trailer to transport equipment. For photography, they provide a stable platform. They are inexpensive, lightweight, stable, reasonably stealthy, and they feature limited draft permitting them to navigate shallow waters (see Figure 6-22). Although useful, boats in this category lack the maneuverability of a kayak and they are not fast unless fitted with an electric motor.

Inflatable boats in this class, as stated, accept electric outboard motors and many accept autopilot (automatic pilot). Autopilot is useful when traveling a long distance because it keeps the boat on course once selecting a com-

pass heading. Autopilot compensates for course altering phenomenon such as wind, waves, and current. When traveling a considerable distance, the autopilot keeping the boat on course minimizes travel distance and that minimizes commute time and battery consumption.

The military uses Zodiac inflatable boats, which are in a different category than the inflatable boat discussed above. Zodiac inflatable boats, commonly referred to as Combat Rubber Raiding Craft and Combat Rubber Reconnaissance Craft (CRRC) carry several people and accept intermediate-powered outboard engines. Appropriate Zodiac models serve well for coastal reconnaissance and clandestine infiltration and exfiltration.

SURVEILLANCE VEHICLES

Relative to vehicle conspicuity, rather than seeking an ideal vehicle color, the surveillance specialist is sometimes better served to determine what colors to avoid in a given circumstance.

Introduction

Vehicles, and especially passenger automobiles, are not ideal for use as an observation post during static (stationary) surveillance. Nevertheless, out of necessity, surveillance specialists use vehicles extensively for that purpose. The frequency with which vehicles serve as an observation post for manual clandestine photography requires that the specialist do everything possible to overcome their shortcomings and maximize their usefulness.

Although vehicles suffer shortcomings as an observation post, the urban environment frequently features other vehicles among which to park in order to be inconspicuous. Blending requires using a vehicle consistent with others in the area relative to make, model, color, and age. In some regions, certain vehicle colors predominate. Additionally, people expect to see late model vehicles in some areas and older vehicles in other areas. For rural use, the color of the vehicle must be consistent with the background against which people will view it.

Before discussing vehicle use for stationary surveillance, discussion addresses vehicle color, automobile window tint, see-through sunscreens, and in-vehicle supplies.

Vehicle Color for Static Surveillance

In the final analysis, it is the nature of the environment more than any universal best color choice that minimizes visibility of a surveillance vehicle.

A surveillance vehicle fleet should feature various makes, models, and colors. Circumstances are varied and the ideal vehicle color varies according to circumstances and region. White vehicles are common in the hot desert region of Phoenix, Arizona (USA) with dark colors more common in cool and cold climates. Nevertheless, many lay people expect surveillance vehicles to be black; a white vehicle is less likely to become suspect although it is more noticeable than some colors. The occupant of the vehicle should wear black or a color that reasonably matches the vehicle interior, black being preferred.

A logical question is, generally speaking, whether certain vehicle colors are better suited for static surveillance by virtue of low visibility. Are certain colors less visible than other colors are? Relative to traffic safety, studies seek to identify the most visible vehicle colors. The surveillance specialist uses the findings of such studies in an attempt to identify the least conspicuous vehicle color for clandestine applications. Unfortunately, there is no ideal vehicle color for static surveillance. Therefore, rather than seeking an ideal vehicle color the specialist is sometimes better served to determine what colors to avoid in a given circumstance.

Researching vehicle color relative to conspicuity as reflected in accident frequency rates leaves it apparent that this topic is fraught with variables. Nevertheless, in spite of numerous variables, studies suggest that the nature of the environment more than any particular vehicle color is what is most important. The AAA Foundation for Traffic Safety confirms the complexity of this topic and provides valuable insight in their *Car Color and Safety White Paper* (2004, July 20, pp. 1–3) that reports:

> The relationship between car color and safety is complex. Background color (trees, desert, etc.), weather conditions (rain, fog, snow), and daylight have a profound effect on conspicuity. . . . At night, white is the most visible, but lime yellow stands out better against cloudy skies and snowy backdrops than does white. The color red is perceived as black at night. . . . When choosing a vehicle, the bottom line is that there is presently no scientific evidence supporting the selection of one particular vehicle color as the unambiguous best choice for safety.

The American Medical Association (AMA) concurs with what the AAA Foundation for Traffic Safety reports in their White Paper. In the *Physician's Guide to Assessing and Counseling Older Drivers* (2010, February 3) the AMA reports that, "vehicle color may enhance or diminish detection under certain traffic conditions (e.g., a white car in snowy weather, or a grey car in rainy or foggy conditions)." In the final analysis, it is the nature of the environment

more than any universal best color choice that minimizes visibility of a surveillance vehicle.

Information under the next subheading provides additional insight into the question of appropriate vehicle color.

Automobile Window Tint and Blackout Curtains

> In an emergency, use masking tape to hang black garbage bags to serve as blackout curtains. Garbage bags weigh so little that masking tape will support them.

Tinted windows provide security by restricting people's view into the vehicle. While darker window tint provides greater security, it reduces the level of incoming light for photography. Reduced light transmission requires using a slower shutter speed, larger lens aperture, faster lens, higher ISO, or a combination of those things. The opaqueness of window tint is a concern when photographing from a surveillance vehicle at night.

The Light Transmittance Value (LTV), also referred to as Visible Light Transmission (VLT), is the opaqueness of window tint expressed as a percentage of light the tinted glass transmits. Fifty percent tint permits 50 percent of the light to pass through the glass. Similarly, 20 percent tint permits 20 percent of the light to pass through the glass, and so on. A lower percentage means lower light transmittance and therefore darker tint.

Surveillance specialists consider the extent of window tint opaqueness relative to concealment needs and photographic needs, each competing with the other. Dark tint provides better concealment than light tint does, but the reduced light transmission of dark tint can create a challenge during nighttime photography, as stated.

For manual clandestine photography, factory-installed tinted windows are preferred for two reasons. First, they permit recording better image quality than windows darkened by use of aftermarket tint film. Second, when applying vacuum cup camera mounts to glass featuring factory-installed tint there is no surface mounted tint film at risk of pulling loose. Factory-installed tinted windows feature tinting on a plastic layer sandwiched between mating sheets of glass.

Window tint, as stated, reduces the amount of light reaching the camera and/or camcorder. The specialist considers window tint opaqueness relative to light loss in terms of number of f-stops. The following table, not exhaustive, illustrates why at night the use of a fast lens is necessary when photographing from a surveillance vehicle featuring tinted windows (see Table 6-1).

Table 6-1
WINDOW TINT DENSITY AND LIGHT LOSS IN TERMS OF F-STOPS

73 percent tint: 2/3 f-stop loss of light
37 perent tint: 1 f-stop loss of light
20 percent tint: 3 1/3 f-stops loss of light
5 percent tint: 4 1/3 f-stops loss of light
The above f-stop values are to the nearest 1/3 stop.

When contemplating the information in Table 6-1 the lesson is clear–use only the degree of tinting that concealment requires. For daytime photography, using a fast telephoto lens usually is not necessary. For nighttime photography, use a fast telephoto lens to compensate for the diminished light transmission. Moreover, when using a binocular from within a surveillance vehicle, use a large aperture binocular to compensate for the diminished light transmission. Consider the Carl Zeiss Victory or Conquest 8x56 binocular, the Victory series being Zeiss' highest performing binocular.

Another reason exists for using only the degree of tinting that concealment requires. The darker the tint the more likely it is that a subject will regard the vehicle with suspicion, especially in regions where heavy window tinting is not common. Dark window tinting is common in the desert region of Phoenix, Arizona (USA), for example, and less common in northern states. Nevertheless, today, the windows of most minivans and SUVs feature some degree of tinting. Therefore, minivan and SUV surveillance vehicles featuring tinted windows are not atypical relative to other vehicles in their class. Nonetheless, use no more tinting than necessary. Realize, however, that even moderately tinted windows will appear black once blackout curtains are in place. Darin Fredrickson, CPP, 19-year Police Detective and President of Team Guardian, LLC, Investigation and Security Specialists, speaking to the issue of vehicle color and window tint, offered the following experience-based insight.

> I have found that many "official" vehicles in Arizona [USA] are white with tinted windows. White vehicles with darkly tinted windows seem to draw attention from suspects. We have a white Town and Country van on our squad, just as my silver Town and Country van. The windows of both vehicles are tinted the same but the white van stands out more with the contrasting blacked out windows. The white color of the van is not so much the problem. Rather, the limo-tinted windows tend to draw attention due to the darkness of the tint being illegal. . . . Here in Arizona, there are more white

> vehicles and therefore white vehicles blend better with other vehicles. If, however, the windows are limo-tinted they tend to attract attention. Realize, however, that we work in an active countersurveillance environment. . . . There needs to be a better compromise between effective concealment versus avoiding being conspicuousness. Perhaps our windows should not be so dark although even lightly tinted windows appear very dark once blackout curtains are in place so maybe tint density does not really matter in this respect. Perhaps we should avoid using white vans. . . . Because we work in an active countersurveillance environment, we observe the subject from as far as conditions permit. When observing a subject from within the van, day or night, I use the Carl Zeiss Victory FL 8x56 T* binocular; it outperforms every binocular I have used during my 19-year law enforcement career. (Detective Darin Fredrickson, personal communication, July 31, 2010)

When the use of aftermarket tint film is necessary, be sure that the density of the tint complies with state law. State laws vary regarding how dark and reflective vehicle windows may be. Before selecting aftermarket tint film, first determine the Light Transmittance Value (LTV) of the existing vehicle windows. The LTV of the existing windows and the LTV of the aftermarket tint film combined must not exceed the legal tint limit.

Usually, supplementing window tint with blackout curtains is necessary (refer ahead to Figure 6-35). For vehicles used frequently for surveillance, have an upholstery shop make a custom fit curtain for each window and apply Velcro tabs for ease of installation and removal. To apply Velcro tabs to the vehicle interior, use Velcro made for plastics, which features a vinyl-friendly adhesive suitable for vehicle interiors. Mount the hook tabs to the vehicle interior and sew the mating loop tabs to the blackout curtains. Adhesive backed Velcro does not work with fabric; sewing the Velcro to the fabric is necessary. Alternatively, use Fabric Fusion™ Velcro tabs for the blackout curtains. This product is a heat-activated adhesive that bonds permanently to fabric when applied using a steam iron. Custom blackout curtains featuring Velcro tabs are surprisingly quick and easy to install and remove. A blackout curtain must also separate the driver area from the rear area of the vehicle.

For limited use vehicles, when frequently switching vehicles, and when using rental vehicles, use gaffer tape to hang generic size rectangular blackout curtains. Gaffer tape is available in various widths and colors, it grips well in virtually all temperature situations, and it leaves no sticky residue when removed. Consider matt black tape for hanging blackout curtains. Masking tape does not work well for hanging blackout curtains.

See-Through Sunscreens

See-through sunscreens reduce light passage thus restricting people's view into the vehicle while permitting the vehicle occupant to see out. Avoid photographing through sunscreens because they badly degrade image quality.

SOPUS Products manufactures the auto/expressions® suncutters® see-through sunscreens for the side and rear windows of automobiles. Made of see-through mesh fabric, the sunscreens serve as a visual barrier and they darken the interior of the vehicle. For clandestine applications, this product performs best when used with vehicles featuring tinted windows and a dark interior color. For additional information, visit the manufacturer's website: www.autoexpressions.com.

During stationary surveillance using an automobile as an observation post, some surveillance specialists place see-through sunscreens on the side and rear windows. They also take a rear-window sunscreen and place it close to the windshield (windscreen). They apply the sunscreens to darken the interior of the vehicle and to restrict outgoing light, which limits an outsider's view into the vehicle while permitting the specialist to see out (see Figure 6-23). The specialist removes the sunscreens before operating the vehicle, removing at least those on the front side windows and the windshield.

If local retailers do not offer see-through sunscreens, purchase them online. One company selling the SunCutter sunscreens featured here is Top of the Line.[9]

In-Vehicle Supplies

In the event that a wary subject looks into the vehicle while it is unattended, they must see nothing that reveals its use for surveillance. They must see no photographic equipment, and see no paperwork with identifying information. When leaving the vehicle, conceal the clipboard or at least lay it face down. Place photographic-related equipment on the floor and cover it with a black cloth, if not concealing it elsewhere in the vehicle. Consider deception such as leaving a trade journal lying on the passenger seat and displaying a fictitious employee-parking permit, both suggesting employment in a field unrelated to investigation. The parking permit can be in the form of a hangtag or window decal. A static cling permit is useful when switching vehicles is necessary. The fictitious employee-parking permit must appear authentic by displaying a company logo and serial number.

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9. Top of the Line. Website: www.topoftheline.com. Click on Auto Sun Shades and then click on Rear Window Shade and Side Window Shade.

Figure 6-23. The see-through Axius SunCutter Rear Profile Window Shade placed near the windshield leaves the surveillance specialist and equipment less conspicuous to people outside the vehicle. *Upper image:* No sunscreen. *Lower image:* See-through sunscreen in place but no blackout curtain separates the front and rear seat areas. Never minimize the value of blackout curtains. This screen measures 48.26 x 101.6 centimeters (19 x 40 inches). The screen works best to restrict view into the vehicle when it is 7.62–12.7 centimeters (3–5 inches) from the windshield (refer to Figure 3-12, upper image, in Chapter 3). Placing see-through sunscreens on the side windows further darkens the vehicle interior. SunCutter sunscreens reduce light passage by approximately 35 lux (3.2 fc/foot candles). *Do not drive with a see-through sunscreen covering the windshield!*

Vehicles used as a vantage point for stationary surveillance must contain certain essential supplies. The following list is not exhaustive; determine what to add and omit based on circumstances and need.

- Communications equipment: two-way radio and cellular phone.
- Cameras, digital single-lens reflex and camcorder.
- Backup cameras (same models).
- Backup camera batteries.
- Backup recording media for the DSLR camera and camcorder.

- Telephoto lenses and tele-converters.
- Battery charger for photographic equipment.
- Camera mounts such as a tripod, window mount, vacuum cup mounts, and in-vehicle support systems.
- Binoculars. Consider the Zeiss Victory FL 8x56 T* or the less expensive Zeiss Conquest 8x56 T*. Also, consider a high magnification image stabilized binocular.
- Spotting scope, consider the Leupold Mark 4 12-40x60 Tactical Spotting Scope, Carl Zeiss DiaScope 65 T* FL, or Carl Zeiss DiaScope 85 T* FL.
- Image intensifier night vision devices for direct viewing and for photography.
- Handheld infrared thermal imager.
- See-through sunscreens.
- Blackout curtains, opaque and/or see-through mesh.
- Clothing changes including hats to alter appearance and to blend with the locale. Some male and female specialists carry one or more wigs, and some carry sunglasses and varied style eyeglasses (zero correction lenses if necessary).
- Gloves.
- First aid kit.
- Flashlight with extra lithium batteries.
- Tool kit.
- Battery jumper cables.
- Second set of vehicle keys.
- Automotive GPS Navigation Unit.
- Road maps.
- Magnetic compass.
- Important persons contact information (hard copy).
- Money (coins and bills).
- Sanitary hand wipes.
- Urinal (male/female) and portable toilet.
- Battery power unit (Fan, air conditioning, etc.).
- Window cleaning supplies–always photograph through clean glass.
- Water and food. Consider a five-day-rated extended cooling chest-cooler (ice chest-cooler) such as Coleman Xtreme and Igloo Max-Cold™.

Elimination of Body Waste

For some reason, surveillance literature avoids addressing this essential topic. At some point during surveillance, the elimination of body wastes becomes necessary. Unfortunately, during stationary surveillance using a vehicle as an observation post, one cannot abort the mission and go in search of a restroom (toilet/water closet). During moving vehicle surveillance, one sometimes needs a means to eliminate body waste once the subject reaches an interim or final destination and parking the surveillance vehicle is possible. The most efficient means to eliminate body waste depends on the type of vehicle in use, whether the surveillance specialist is male or female, and preference is a concern.

Male surveillance specialists commonly urinate into a jar or bottle but for women a jar or bottle is problematic. Medical supply stores sell male and female plastic urinals at reasonable cost. After use, empty urinal content into a larger spill proof container. In addition to plastic urinals, miscellaneous other products accommodate the urination needs of women, one example being the SheWee. In addition, manufacturers offer a variety of flushable and non-flushable portable toilets, the inexpensive but efficient nonflushable Luggable Loo featured here (see Figure 6-24).

Passenger Cars, SUVs, Minivans, Pickup Trucks, and Box Vans

When movement is necessary while photographing from the front seat of a parked vehicle, move very slowly. The human eye, even peripheral vision, detects quick movement. Extremely slow movement goes unnoticed.

Introduction

This section discusses manual clandestine photography from within vehicles, some types of vehicles being more suitable for this purpose than others are. Naturally, circumstances determine the most appropriate type of vehicle to use and the type of vehicle determines how the surveillance specialist outfits it. Appropriately equipped, most vehicle types are suitable for use as a photographic vantage point.

Before discussing methods for using suitably equipped vehicles as a photographic vantage point, discussion must address those fast-moving situations wherein the surveillance specialist must get a camera or camcorder on the subject immediately. There are instances when no time exists to set up for manual clandestine photography in a desired manner such as placing the camera or camcorder on a solid support. Sometimes, for example, when the

Figure 6-24. Vehicles used for surveillance must contain provision for the elimination of body wastes. *Upper left image:* The SheWee Plastic Urine Funnel is a portable device that permits women to urinate in the standing or kneeling position, doing so without removing clothing (www.shewee.com). *Upper right image:* The Reliance Luggable Loo portable toilet is available as a complete unit or one may purchase the toilet seat separately and snap it to a standard 5-gallon (19 liters) plastic pail. One may insert the manufacturer provided Double Doodie waste bag featuring a double zip locking mechanism, or insert an appropriate sized drawstring garbage bag containing cat liter. *Lower left image:* Plastic urinal–female. *Lower right image:* Plastic urinal–male. Another option for female surveillance specialists is a bedpan. Research the topic because male and female versions exist and for each, different styles are available. Moreover, one can purchase an inexpensive plastic bedpan or a more expensive stainless steel bedpan. Some bedpans feature a cover and some do not.

subject of moving vehicle surveillance reaches an interim or final destination the specialist must quickly park and immediately begin photographing with a single-image camera or camcorder.

One example of a situation requiring spontaneous photography or videography is when the subject of moving vehicle surveillance parks and immediately somebody approaches the vehicle. Whether the person approaches the vehicle to speak with the subject or to sell or purchase contraband, their interaction is sometimes very brief. In such instances, the surveillance specialist must park the vehicle and get a camera or camcorder on the subject immediately to document the activity. In instances such as this, the specialist often must photograph from the front seat of the vehicle with only distance and discreet behavior providing cover.

Appropriate distance provides cover and that is fortunate because, as stated, fast moving situations often require spontaneous photography from the front seat of the vehicle. Chapter 3, under the subheading *Vehicle Window Mounts,* discusses the minimum distances from which a subject with unaided vision can discern that the occupant of a parked vehicle is using a camera, camcorder, or binocular.

Sometimes the distance between the surveillance specialist and subject is not sufficient to provide adequate cover. When photographing from a short distance, being inconspicuous and motionless minimizes the likelihood of detection. This is why dark-colored vehicle interiors and dark clothing are preferred. Tinted window glass also helps to escape detection.

When circumstances permit, sit on the side of the vehicle opposite the window through which photographing occurs. Even better, sit in the back seat and photograph through an open front side window, photographing through the space between the backs of bucket seats. Some short-range situations require photographing through the glass of a closed vehicle window.

When photographing from the front seat, the likelihood of detection diminishes when activity in the area captures people's attention, unrelated activity serving as a diversion. Somebody sitting in a parked vehicle in a busy shopping center parking lot is less conspicuous than somebody sitting in a vehicle parked in a company's employee parking lot, for example. Shopping mall parking lots are continually busy as shoppers arrive and leave. Conversely, employee parking lots are busy only during shift changes. Consider environmental dynamics such as this when deciding where to park the vehicle for use as a photographic vantage point. Anticipated duration of the stakeout is also a factor to consider when determining where to park the vehicle. Have a pretext story in mind to justify sitting in the vehicle should a curious security officer become inquisitive.

When body movement is necessary while photographing from the front seat of a parked vehicle, move very slowly. The human eye, even peripheral vision, detects quick movement. Extremely slow movement tends to go unnoticed. Moreover, when movement is necessary and circumstances permit, execute movement when something in the environment captures the subject's attention. This concept applies also to sound. A surveillance specialist doing stakeout from a vehicle during winter months would periodically start his vehicle engine for warmth. He started his engine when the sound of loud trucks passing the subject location masked the sound of his engine starting.

The following two sets of images show effective videography methods when working from the front seat of a vehicle is necessary (see Figures 6-25 and 6-26).

In the urban environment, a nondescript vehicle parked among other vehicles tends to go unnoticed, but it is conspicuous when parked alone or in direct view (see Figure 6-27). Moreover, photographing from the back seat of a vehicle leaves the surveillance specialist less conspicuous than when photographing from the front seat, previously stated (see Figure 6-28). Finally, the farther the vehicle is from the subject the less likely detection is to occur, that too previously discussed.

In some instances, photographic images must identify what the subject or an associate has in hand such as objects or printed material. Naturally, this requires more magnification than is required to record subject identification (i.e., facial recognition). A quality zoom lens featuring a focal length range suitable for the distance permits photographing the general area of the subject and then zooming in for close-up views when necessary. Additionally, high-resolution daytime images permit considerable enlargement to identify what a subject has in hand (see Figure 6-29).

When photographing from the front seat of a vehicle is necessary and distance is sufficient to provide cover, place a short section of foam pipe insulation on the window glass to support the telephoto lens. The insulation serves as a soft slip-free lens support (see Figure 6-30). Two types of foam pipe insulation are available, self-sealing and nonsealing. Use nonsealing insulation because it features no adhesive and therefore it will not stick to the window glass.

Passenger Cars

When photographing from a passenger car, the surveillance specialist can photograph through the windshield (windscreen), side windows, or rear window. Best image quality results when photographing through side win-

Figure 6-25. Using the Canon Elura 100 Mini DV camcorder, this surveillance specialist demonstrates a variety of methods for filming from the front seat of a vehicle during intermediate-range videography. Observe that she uses a grocery store beanbag to support the camera. *Upper left image:* Filming through the steering wheel is discrete because, to people outside the vehicle, the specialist appears to have her hands on the steering wheel. In some vehicles, the height of the dash relative to the steering wheel disallows this method. *Upper right image:* With the headrest removed, the back of the passenger side bucket seat serves as a support for the beanbag and camcorder. *Lower left image:* A plastic toolbox supports the beanbag and camcorder. *Lower right image:* The back of the front bucket seat is reclined with the back of the rear seat supporting the beanbag and camcorder. To accomplish that, she removed the headrest from the back seat. Several factors minimize the likelihood that the subject will become aware of this specialist. Observer-to-subject distance is adequate, the vehicle is ubiquitous (common for the area), the vehicle sits in a driveway like other vehicles in the vicinity, windows are closed, she keeps her body out of view to the extent possible, she minimizes body movement, and all necessary body movement is done slowly. Images courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

dow glass. Photographing through the windshield offers less image quality and the rear window usually results in the lowest image quality. For best results, when circumstances permit, photograph through the opening of a partially or fully rolled down side window. Rolling the window down a short distance is often adequate (refer to Figure 3-9, upper image, in Chapter 3).

When photographing from within a vehicle, best results occur when the camera is on a firm support. A firm support is necessary for single-image

Figure 6-26. The surveillance specialist demonstrates a variety of methods for using a camcorder from the front seat of a vehicle. *Upper left image:* Her knee supports the beanbag and camcorder. *Upper right image:* Camcorder on the dash supported by a small beanbag. *Lower left image:* Modified beverage holder with suction cups supports a beanbag and camcorder. Applying this support to the window requires virtually no time, which makes it ideal for spontaneous videography. Removal is also quick. *Lower right image:* Appropriate body position provides camcorder support. Observe that her elbows are on the fleshy part of her knees, which has ergonomic value and dampens vibration transmission to the camcorder. Images courtesy of Johnston and Dana Blakley, Investigative Training, North Palm Beach, Florida (USA).

cameras and for camcorders, support being especially important when using a telephoto lens. Chapter 3 illustrates a variety of camera/camcorder support systems for use inside vehicles.

When using vehicles as an observation post for stationary photographic surveillance, be creative in the choice of vehicle and the manner of application (see Figures 6-31 to 6-34).

SUVs and Minivans

Surveillance specialists frequently use Sport Utility Vehicles (SUVs) and Minivans as an observation post for stationary photographic surveillance. Vehicles in this class are popular with specialists because they are ubiquitous

Figure 6-27. In each image, the surveillance specialist is photographing from the driver's seat of the vehicle, looking into the camera viewfinder. A vehicle parked alone or in direct view is conspicuous (upper image) while a vehicle obscured by other parked vehicles tends to go unnoticed (lower image). Additionally, being farther from the subject makes detection less likely. Generally, with normal but unaided vision, from a distance of 229 meters (250 yards), a subject cannot discern that a vehicle occupant is looking through a handheld camera, especially when the camera is appropriately subdued (refer to Figure 3-31 in Chapter 3). The camera featured here is subdued and it sports a 15-degree antireflection device (ARD).

(everywhere), they are effective, and subjects usually regard them with less suspicion than they do a full size van. Using an SUV or minivan as a vantage point for extended stationary surveillance usually requires the application of blackout curtains (see Figure 6-35).

It is a personal choice whether to use fully or partially opaque blackout curtains. If fully opaque curtains are the choice, consider making the curtains using sound absorption blanket material. People in the motion picture and recording industries use sound absorption blankets. Blackout curtains made from such material work well for concealment and they add sound and thermal insulation. The specialist can use gaffer tape to hang generic size sound absorption material in the vehicle or make custom-fit curtains using such material. Filmtools® sells sound absorption blankets that they describe as follows.

> Furniture Pads are also commonly referred to as Sound Blankets, Moving Blankets, Moving Pads, Furni Pads, and many other names. . . . The Filmtools Furniture Pad/Sound Blanket is made of Heavy Duty, Solid Black

Figure 6-28. The surveillance specialist is conspicuous when photographing from the front seat of the vehicle (upper image) but largely undetectable when photographing from the rear area, photographing between the backs of the front bucket seats (lower image). The specialist is using a DSLR camera with a zoom lens fitted with an antireflection device (ARD). Additionally, he subdued the camera using matt black gaffer tape (refer to Figure 3-31 in Chapter 3 to view the subdued camera he is using here). To prevent visual detection a see-through sunscreen covers the window of the driver's side rear door. A blackout curtain covers the window of the passenger's side rear door. When photographing from the front seat of a vehicle is necessary and circumstances permit, photograph from a greater distance and consider placing an antireflection device (ARD) on the lens as illustrated here. When photographing from the front seat is necessary, sitting in the seat opposite the open window reduces the likelihood of detection. For example, when photographing through the driver side window, sit in the passenger seat. When photographing from the driver seat, attempt to position the vehicle so that photographing through the passenger side window is possible. Alternatively, position the vehicle so that photographing through a tinted rear side window is possible, these tactics illustrated shortly.

> material that can be hung in a room for added sound insulation or even used to block out light from a window. (Filmtools, 2010, n.p., *Filmtools Sound Blanket*).

When circumstances require spontaneous handheld photography from the front seat of a passenger car, SUV, or minivan, park facing somewhat

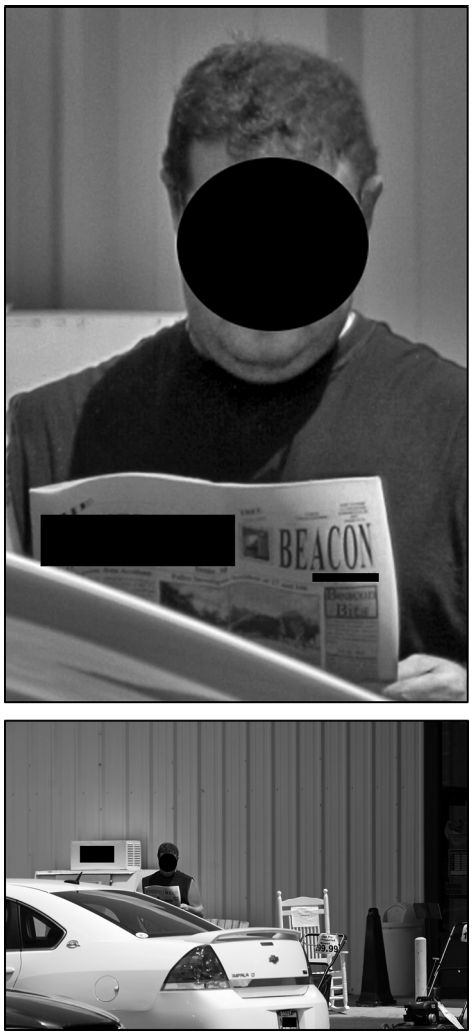

Figure 6-29. The upper image is a cropped portion of the lower image. In some instances, photographic images must identify what the subject or an associate has in hand such as objects or printed material. A zoom lens permits recording the general area of the subject and then zooming in for a close-up views when necessary. The date of the newspaper is legible in the original photograph. Although photographing from a surveillance van in this instance, a minivan, the surveillance specialist recorded this image using the camera handheld while photographing out an open front side window, photographing between the backs of the bucket seats. *Camera-to-subject distance:* Approximately 41 meters (45 yards). *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* Canon EF 70-300mm f/4-5.6 IS USM zoom lens at 200mm. Had the newspaper been of importance under the circumstances the specialist would have photographed it as full zoom, 300mm, to record better detail. *ISO:* 200. *Shutter speed:* 1/1000 second. *Aperture:* f/6.7. The Canon Web site product description states that the image stabilization feature of this lens provides up to three stops of shake correction.

Figure 6-30. A short section of nonsealing foam pipe insulation applied to a vehicle window provides a soft slip-free support for a telephoto lens. The surveillance specialist's dark gray hat is visually lost in the darkness of the vehicle.

away from the subject and photograph through a tinted rear side window (see Figure 6-36.).

The factory tinted window glass of minivans and SUVs degrade image quality very little when using a moderate focal length conventional telephoto lens, but image degradation occurs when using a large aperture Schmidt-Cassegrain telescope (see Figure 6-37 and refer ahead to Figure 6-38).

Surveillance specialists, once in position for a stakeout using an SUV or minivan equipped with blackout curtains, commonly mount the camera or camcorder on a stable support. That works well with a defined subject area. When the precise subject area is unknown, and in situations where the subject moves about the scene the specialist needs camera mobility. For example, a subject exiting a building and walking to a vehicle some distance away is difficult to follow without camera mobility In such instances, the specialist handholds the camera or uses it with a short monopod, fluid head, Wimberley Head Version II, or uses the Body Mount Supporter. All methods provide mobility of the camera or camcorder.

Image quality is usually good when photographing through factory tinted side and rear windows of SUVs and minivans using a short to moderate telephoto lens. Results are poor when photographing through the same windows using a large diameter high-magnification Schmidt-Cassegrain tele-

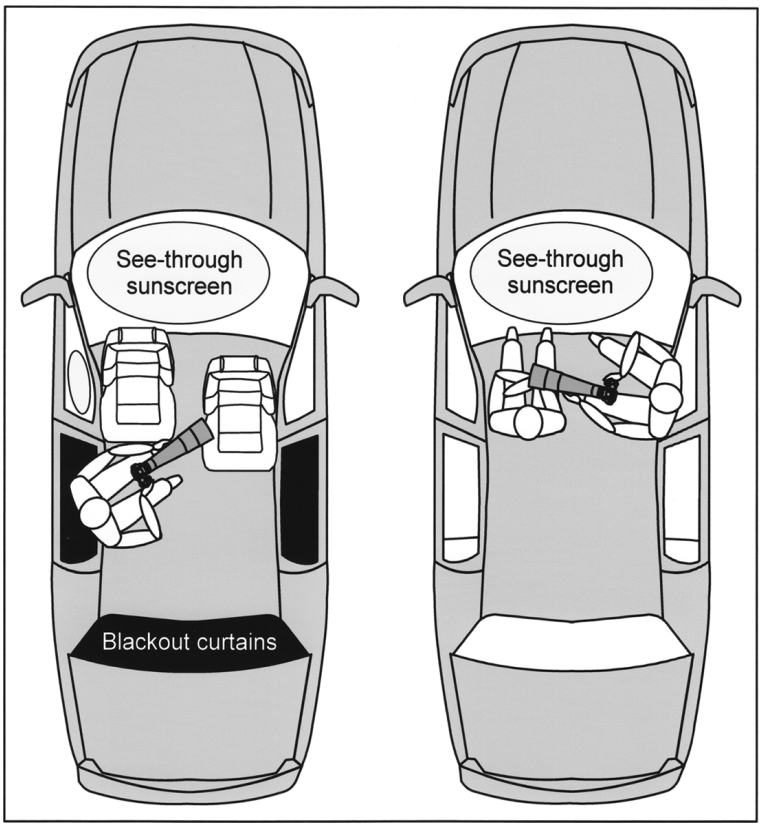

Figure 6-31. When photographing from within an automobile, several seating options are possible, two potentials shown here. *Left image:* When necessary, offset the position of the front bucket seats, one forward and one back, to provide the space needed to photograph between them from the backseat area (refer ahead to Figure 6-34, that image recorded using this method). A see-through sunscreen covers the windshield (windscreen). Depending on circumstances, placing a see-through sunscreen on the front side window opposite the window through which photographing occurs may be desirable. From the rear seat, the surveillance specialist can also photograph through a square or rectangular opening in a blackout curtain (refer ahead to Figure 6-33). *Right image:* The surveillance specialist is photographing across the front of the driver who provides some degree of visual cover (refer to Figure 4-48 in Chapter 4, that image recorded using this method).

scope (see Figure 6-38). A small-diameter lens accepts light passing through a limited area of the window glass so incoming light rays are for the most part parallel. A large-diameter lens accepts light passing through a large area of the window glass, which creates an image quality problem because the glass is convex and wavy in a nonuniform way. As a result, incoming light rays are not parallel.

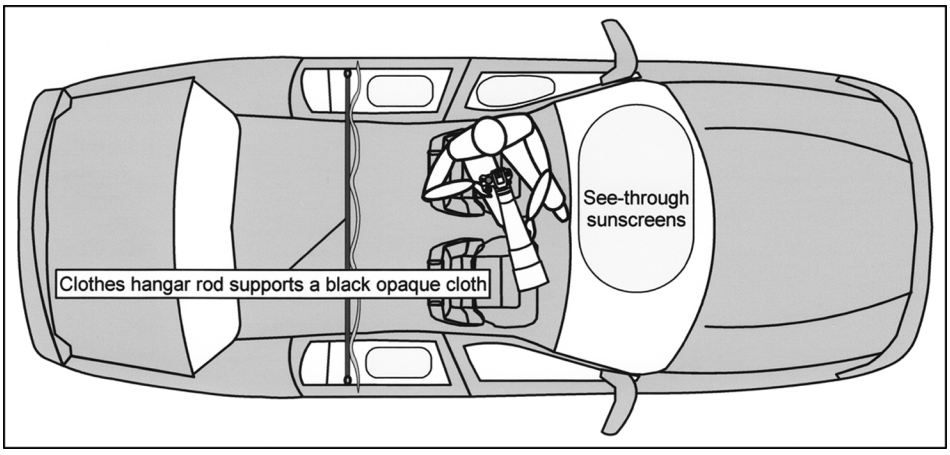

Figure 6-32. To prevent light passing through the vehicle from front to back and making vehicle occupancy apparent, surveillance specialists suspend a black opaque cloth from a clothes hangar rod. This applies to passenger cars, SUVs, and minivans. The surveillance specialist should wear black or wear a color consistent with the color of the vehicle interior, black preferred in most instances. Proper placement of see-through sunscreens further reduces the likelihood of detection (refer back to Figure 6-23 and refer to Figure 3-12, upper image, in Chapter 3). Photographing from the seat opposite the open window minimizes the likelihood of detection by the subject.

Pickup Trucks and Box Vans

Depending on circumstances, trucks serve well as a static observation post for visual and photographic surveillance (see Figure 6-39). In some situations, a parked truck generates less suspicion than some other type of vehicle such as a black official looking van. Just as passenger cars, minivans, and sports utility vehicles (SUVs), trucks require proper use of blackout curtains. The use of pickup trucks with topper shells is discussed more comprehensively later under the heading *Configuring Surveillance Vehicles In-House.*

Professionally Manufactured Surveillance Vans

Manufacturers of surveillance vans usually provide standard equipment and they offer a variety of optional apparatus. Larger vehicles commonly feature a 360-degree pan/tilt/zoom (PTZ) remote-controlled retractable periscope with quick-change cameras and lenses.

Surveillance vans fabricated by specialty manufacturers are to some extent custom configurations. The manufacturer begins with a stock minivan, mid-size van, large utility van or some other suitable vehicle and outfits it

Figure 6-33. Wood's Powr-Grip Concave Vacuum Cup with Cleat Head (LJ45PHC) supports the Canon VIXIA HV30 high-definition (HD) camcorder sporting the 1.7x teleextender lens (refer to Figure 3-8 in Chapter 3 for a close-up view of this camcorder and vacuum mount). With the camcorder framed to record the overall scene, recording continuously, the surveillance specialist uses the digital single-lens reflex (DSLR) camera with a telephoto lens to record high-definition single images; an appropriate DSLR camera permits recording close-up HD video. The tripod supports a full-frame DSLR camera sporting the Canon EF 300mm f/2.8L IS USM telephoto lens. The simple folding bench permits the specialist to sit facing the camera for efficiency and to minimize fatigue. In some instances, to achieve more working space removal of the back seat is desirable. Tinted windows and opaque blackout curtains permit the specialist to work undetected. Some specialists favor black mesh cloth that permits them to see out but restricts people's view into the vehicle. In some instances, a parked passenger car generates less suspicion than a parked van, minivan, or SUV. Consider this when confronted with an active countersurveillance environment. Using a pretext is sometimes desirable or necessary when parking the vehicle. Refer ahead to subheading *Pretexts and Trap Lines.*

according to customer needs. Providing an exterior view of a surveillance vehicle would serve no useful purpose since they look like any nonsurveillance vehicle of the same make, model, and year.

The manufacturer installs custom interior finish such as cabinetry and assorted photographic and related equipment including, in many instances, a remote controlled retractable periscope with quick change cameras and lenses (see Figures 6-40 to 6-43). The periscope system features an effective

Figure 6-34. *Camera-to-subject distance:* 66.75 meters (73 yards). The surveillance specialist recorded this image handholding the camera while sitting in the backseat of a parked passenger car. The specialist photographed through the open front driver's side window, photographing through the space between the backs of bucket seats. The tinted vehicle windows with see-through sunscreens prevented detection. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* Canon EF 70-300mm f/4-5.6 IS USM zoom lens at full zoom. *ISO:* 200. *Shutter speed:* 1/250 second. *Aperture:* f/5.6. The Canon Web site product description states that the image stabilization feature of this lens provides up to three stops of shake correction. Indeed, this is an easy lens to handhold and work with for intermediate-range clandestine photography during daylight hours. This image verifies that a crop-sensor DSLR camera is suitable for many clandestine photography applications. Consider using a crop-sensor DSLR camera featuring HD video capture. The upper image shows the location of the surveillance vehicle and the subject. Photographing from the parking lot across the street minimized the likelihood of detection by the subject although vehicle traffic periodically blocked the specialist's view of the subject location, a circumstance that could prevent recording a brief decisive moment.

camera-to-subject distance of approximately 0.39 kilometer (1/4 mile). Naturally, maximum range varies according to the focal length of the lens, atmospheric conditions, and the extent of near ground thermals (convection currents). Commonly the focal length of the periscope camera's zoom lens is approximately 6-140 millimeters.

Figure 6-35. Surveillance specialists frequently photograph from the rear area of a sport utility vehicle (SUV) or a minivan featuring tinted windows. Commonly, they use fully or partially opaque blackout curtains to enhance concealment. Partially opaque see-through curtains restrict an outsider's view into the vehicle but permit the specialist to see out. A blackout curtain separates the front seat area from the rear area. The upper image shows the camera system this specialist uses with the blackout curtains removed for illustration purposes. The lower image shows generic size blackout curtains held in place using gaffer tape. Even with the liftgate raised, the camera system is difficult to see; a surveillance specialist dressed in black would be equally difficult to see. Naturally, during use, the liftgate is closed and a blackout curtain covers the liftgate window. The specialist can photograph through a gap between two rear window curtains or photograph through an opening in a single curtain. Vehicles with a light colored interior are suitable for surveillance when using blackout curtains. The digital single-lens reflex camera and camcorder are mounted side-by-side and move as an integrated unit, a setup that permits the simultaneous recording of moving video images and high-definition still images. It also permits long duration camcorder recording while using the HD video mode of a DSLR camera for short duration high-detail recording. The Celestron mini-geared head supporting the camcorder permits precise alignment of the two optical systems. In this instance, the previously featured custom-made low-profile tripod would serve well (refer to Figure 3-14 in Chapter 3).

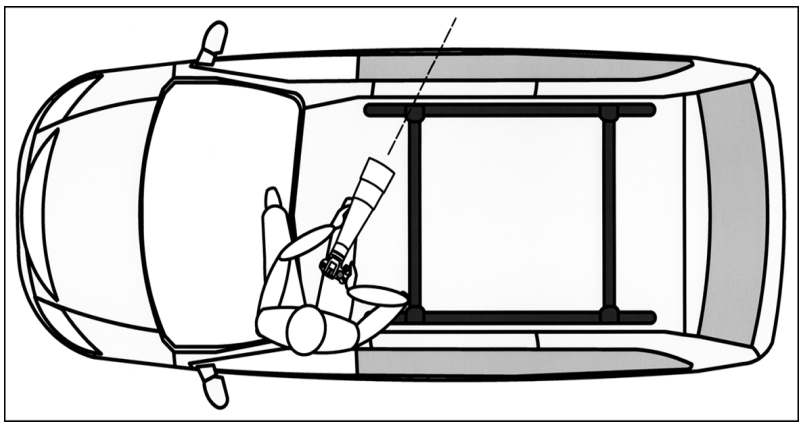

Figure 6-36. The surveillance specialist parked the vehicle facing somewhat away from the subject and photographs through the tinted window.

Figure 6-37. From within a minivan featuring blackout curtains and 20 percent factory tinted windows, the surveillance specialist photographed this subject while handholding the camera. To achieve a faster shutter speed, the specialist increased ISO from 100 to 200, the higher ISO partially compensating for the light loss of approximately 3 1/2 f-stops caused by the tinted windows. *Camera-to-subject distance:* Approximately 27.43 meters (30 yards). *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* Canon EF 70-300mm f/4-5.6 IS USM zoom lens at 200mm. *ISO:* 200. *Shutter speed:* 1/350 second. *Aperture:* f/4. The Canon website product description states that the image stabilization feature of this lens provides up to three stops of shake correction.

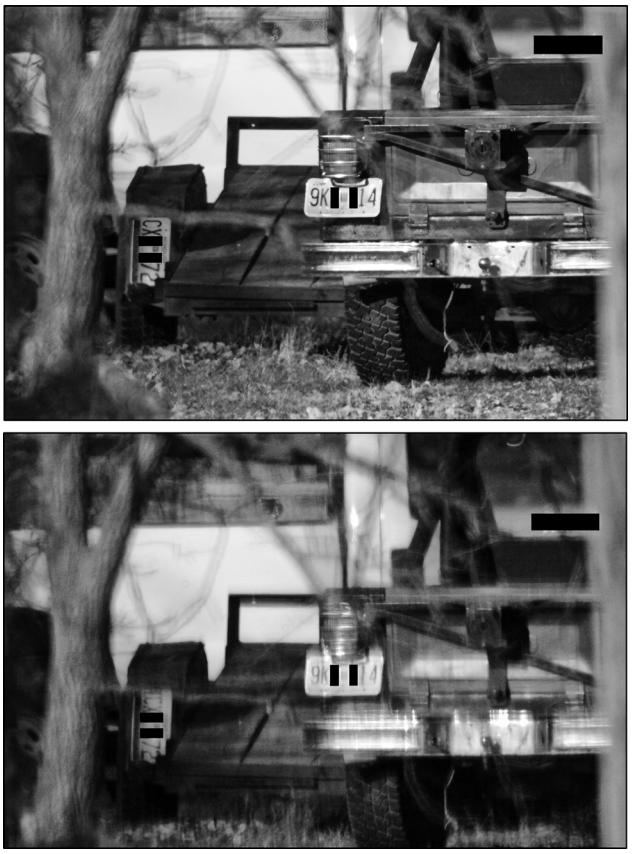

Figure 6-38. Vehicle windows are intolerant of large diameter Schmidt-Cassegrain telescopes. From a distance of 247 meters (270 yards), the surveillance specialist recorded the upper image through the open minivan door. Then, through the 20 percent factory-tinted window of the closed door, he recorded the lower image. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope. When photographing through vehicle windows, use the smallest diameter lens that circumstances permit. The larger the diameter of the lens, the more the nonuniform surface, shape, and thickness of the glass degrades image quality.

Manufacturers of surveillance vans usually provide standard equipment and they offer a variety of optional apparatus. The following is equipment commonly found on surveillance vans:

- 360-degree pan/tilt/zoom (PTZ) remote-controlled retractable periscope with quick change cameras and lenses.
- Day and night high-resolution digital camera systems.
- Strategically located pan/tilt/zoom (PTZ) video cameras.

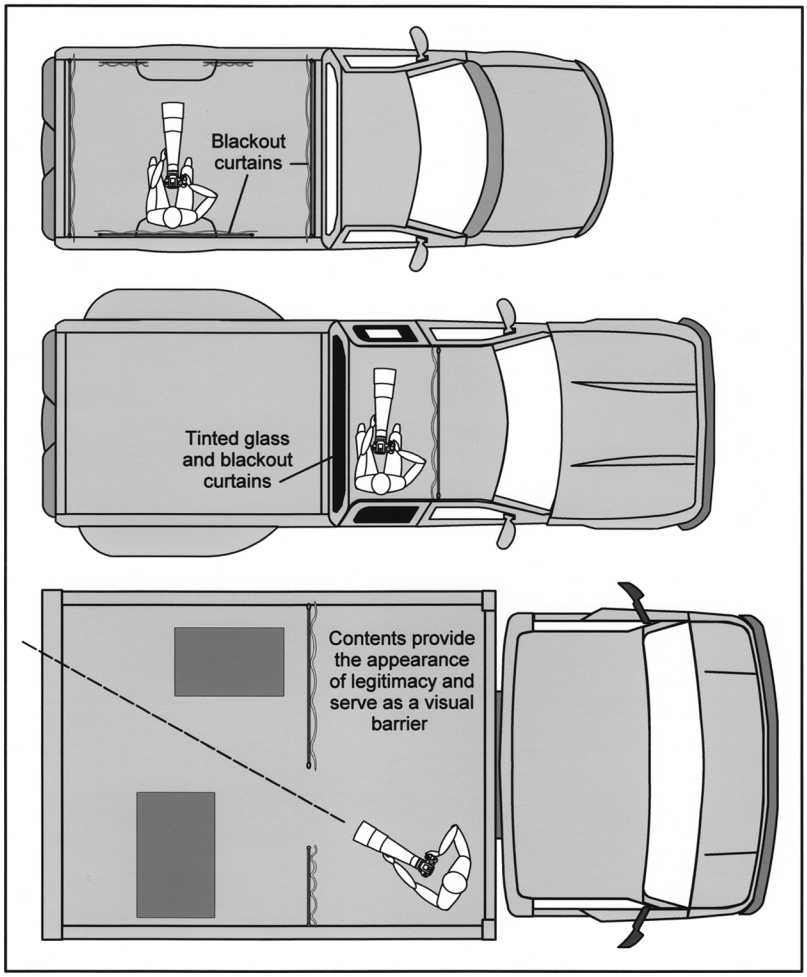

Figure 6-39. In some instances, pickup trucks and box vans are suitable observation posts for stationary (static) photographic surveillance, especially in active countersurveillance environments. Properly used, they minimize the likelihood of discovery by the subject (i.e., being *made* or *burned*). *Upper image:* Pickup trucks with a topper shell are effective observation posts. *Center image:* The rear seat area of an extended cab pickup truck is configured much the same as the back seat area of a passenger car (refer back to Figure 6-33). An extended cab pickup truck without a topper shell is unlikely to become suspect. *Lower image:* Box vans provide good concealment, but they are suitable only in some locations. Potential duration of their use depends on circumstances.

- Thermal imaging system.
- Tinted windows that permit photography but restrict view into the van.
- Audio recording and logging system.
- Built-in color flat screen monitors.

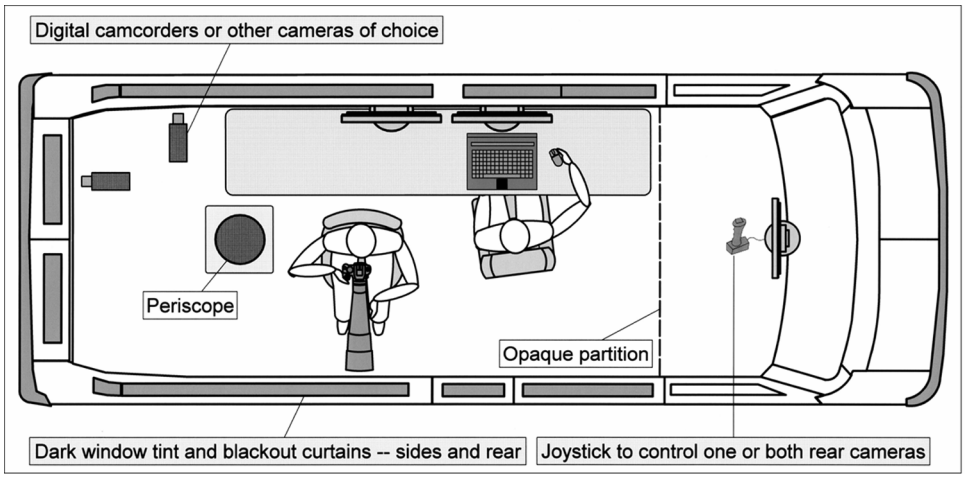

Figure 6-40. The layout featured here is typical of surveillance vans configured using cargo vans although variations exist. Not shown in this illustration are the batteries and the self-contained battery-powered HVAC (Heating, ventilating, and air condition) system–they go where space permits. Other equipment goes where operators can use them efficiently, and where space permits. The portion of the remote-controlled retractable periscope that extends above the roof looks like an air vent; the operator raises it when needed and lowers it when not needed. Inside the van, mounted to the periscope is a camera the operator remotely controls from the workstation. Other cameras of choice supported by small tripods, pedestals, or articulating arms record through openings in the blackout curtains that cover the side and rear tinted windows. Alternatively, mounting cameras on a pan/tilt mechanism permits operating them from the front seat by means of a joystick.

- Communication systems.
- Desk space.
- Comfortable seats to minimize fatigue during extended operations.
- Self-contained battery-powered heating, ventilating, and air condition (HVAC) system.
- Portable toilet.
- Vans are insulated to minimize the HVAC system battery demand, the insulation also serving as a sound barrier.

Configuring Surveillance Vehicles In-House

Manufacturing a surveillance vehicle in-house is simply a matter of obtaining the preferred vehicle and then installing desired furnishings and equipment.

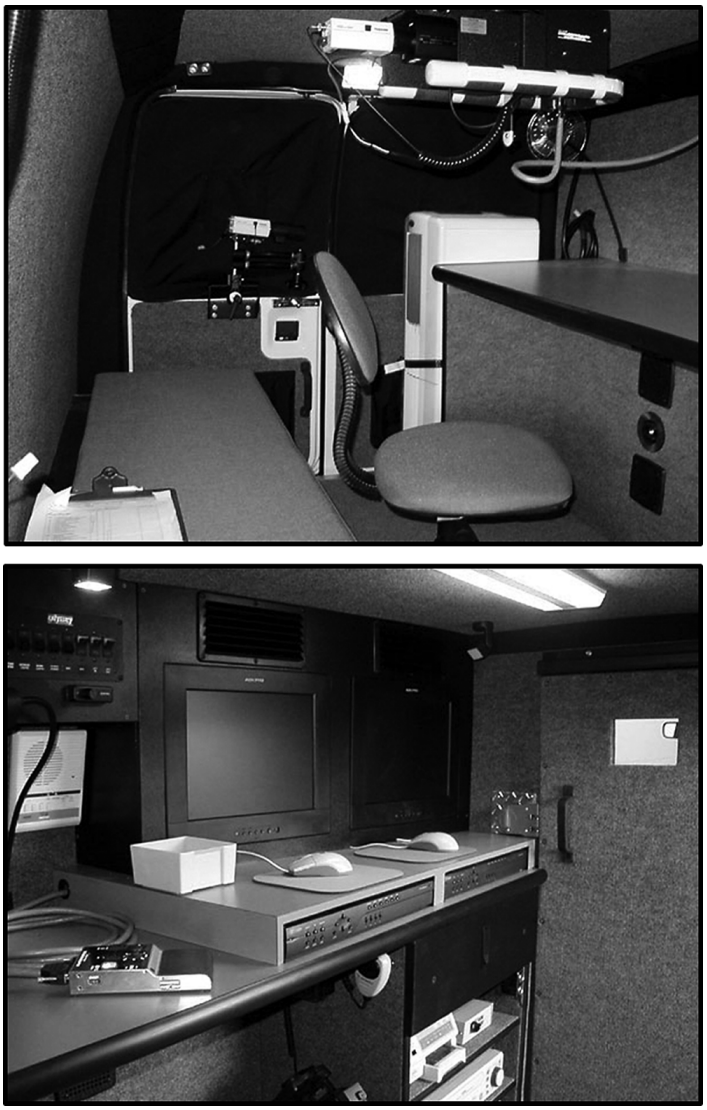

Figure 6-41. This American-made large surveillance van features a disguise roof-rack, bench for electronic equipment, cabinetry, insulated and carpet interior, 360-degree pan/tilt/zoom (PTZ) remote-controlled retractable periscope with quick change cameras and lenses, side view camera locations, blackout curtains, intercom system and locking steel partition between the driver and operator compartments, batteries and shoreline, and a heating and cooling system. Images courtesy of Odyssey Automotive Specialty.[10]

10. Odyssey Automotive Specialty. Telephone: 1.800.535.9441 and 973.328.2667. Fax: 973.328.2639. E-mail: sales@odysseyauto.com. Website: www.odysseyauto.com. Physical address: 317 Richard Mine Road, Wharton, NJ (USA) 07885.

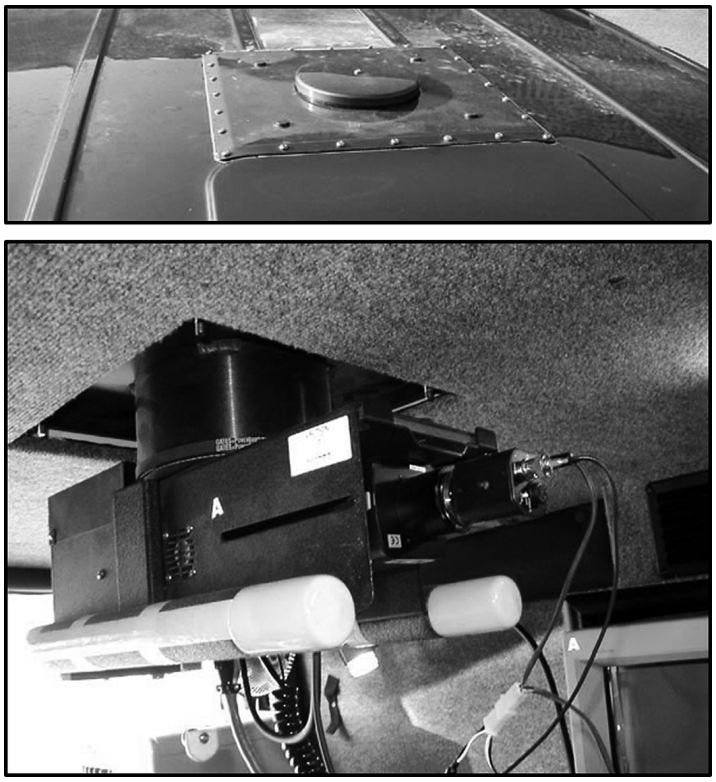

Figure 6-42. Interior and exterior view of the 360-degree pan/tilt/zoom (PTZ) R/5 remote-controlled retractable periscope with quick change cameras and lenses. Images courtesy of Odyssey Automotive Specialty.

Introduction

With a reasonable amount of ingenuity and fabrication skill, creating one's own surveillance vehicle is not difficult. Private investigators more often than government personnel fabricate surveillance vehicles in-house with simplified versions being the usual result. The surveillance specialist creates a surveillance vehicle by retrofitting the vehicle of choice, usually an SUV, minivan, or full-size van. Commonly the specialist installs a workstation, blackout curtains, camera/camcorder mounting systems, toilet facility, and a self-contained heating, ventilating, and air conditioning (HVAC) system.

Insulating the vehicle is desirable and can range from simply applying floor carpeting to interior surfaces to installing substantial insulation. Quality insulation increases comfort, increases the run time of a battery-based HVAC system, and it serves as a sound barrier.

Figure 6-43. Small surveillance vans offer many of the features of large surveillance vans but without a 360-degree retractable periscope camera system. Image courtesy of Odyssey Automotive Specialty.

SUVs, Minivans, and Full-Size Vans

Manufacturing a surveillance vehicle in-house is simply a matter of obtaining the preferred vehicle and then installing desired furnishings and equipment (e.g., workstation, cameras, and communication equipment). Accomplishing in-house what specialty manufacturers of surveillance vehicles achieve is feasible because all the necessary components are available on the commercial market. In fact, the imaginative individual can probably enhance photographic performance of the vehicle by incorporating unorthodox hybrid innovations. Indeed, advancements in photographic and related technologies, and some not so related but applicable technologies, provide the opportunity to create hybrid application methods that exceed current practices. In this respect, the authors see potential. Many of today's standard practices began as unorthodox and hybrid methods.

Pickup Truck Topper Shells

Surveillance vehicles need not be elaborately equipped to be effective. One of the authors frequently photographed from a pickup truck with a topper shell, sitting on a stool using a tripod mounted camera system. The vehi-

cle featured no special provisions for surveillance other than blackout curtains. A private investigation agency specializing in surveillance for the insurance industry has a fleet of pickup trucks with Deluxe Commercial Unit (DCU) contractor topper shells made by A.R.E. Each truck features a workstation and a 360-degree periscope. When necessary, the surveillance specialist photographs through the glass of the one-half rear lift door or from the driver compartment as he or she would from any other type of vehicle. In addition to photographing from the pickup trucks, specialists photograph from passenger cars, SUVs, minivans, full-size vans, and from nonvehicle vantage points.

Slide-In Cab-Over Truck Campers

> Those without surveillance experience should use a binocular to observe activity on the opposite side of a roadway. Quickly it will be apparent that vehicle traffic interrupts continuity of observation thus illustrating the benefit of an elevated vantage point.

Available in a variety of sizes, slide-in cab-over truck campers work well for visual and photographic surveillance in some environments. The surveillance specialist can photograph from a camper in an unmodified state or outfit it similar to the manufactured surveillance vans previously discussed (see Figure 6-44a).

Slide-in cab-over truck campers provide many benefits when used for stationary (static) manual clandestine photography. Some of the benefits in no particular order include but are not limited to the following:

- In many regions, slide-in cab-over truck campers are commonplace. Neither do criminals and members of the public associate truck campers with clandestine operations. Moreover, campers are suited for rural use in many instances.
- The windows of the cab-over area (bed area) permit viewing over automobiles which contributes to uninterrupted observation; passing traffic and somebody parking next to the camper is unlikely to block the view. The height of the windows also places a camera or camcorder above the worst of the near ground image-degrading thermals (convection currents). Although height varies by truck and camper model, the horizontal centerline of the cab-over window (bed area) is approximately 2.286 meters (7.5 feet) above the ground. Most full size passenger cars are no more than 1.524 meters (5 feet) high.
- The roof height, being approximately 2.52-2.59 meters (8.25-8.5 feet) places the periscope view above the worst of the near ground image-

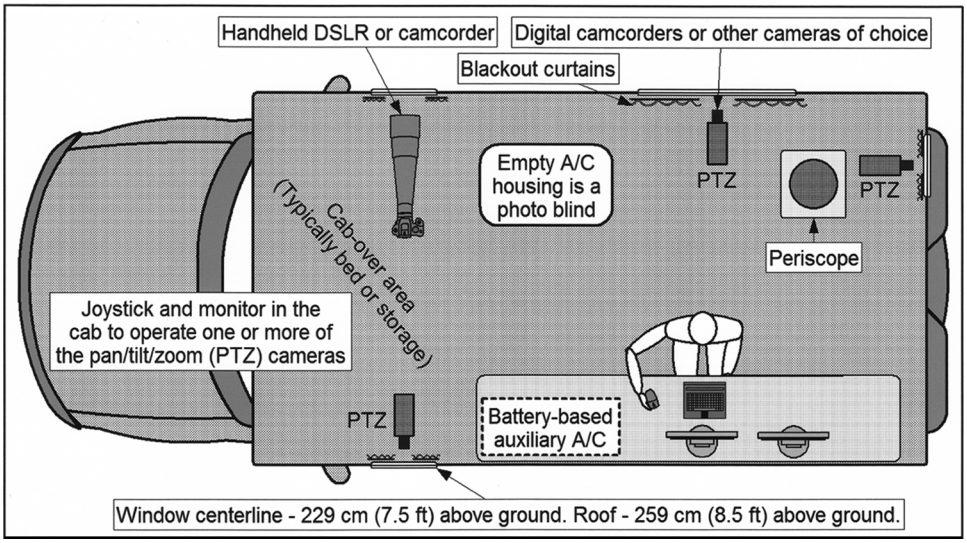

Figure 6-44a. It is possible to outfit a slide-in cab-over truck camper in a manner similar to manufactured surveillance vans. Place civilian looking curtains over windows with blackout backing. Once determining the windows through which photographing will occur, consider replacing the factory installed glass with quality 1/4-inch plate glass, if that is necessary for clarity of photographic images. Consider tinted 1/4-inch thick low-iron glare-free plate glass.[11]

degrading thermals. That increases the quality of photographic images and it increases operating range.

- Switching the supporting truck is quick and easy. Switching trucks is necessary when the vehicle requires mechanical service and when changing vehicle appearance is necessary.
- The cab-over area (bed area) is an ideal location to place a high-magnification lens such as a Schmidt-Cassegrain telescope (SCT). Outfitted with such a lens, the vehicle is suitable for ultra long-range daytime and night vision photography. When used in this manner,

11. The authors acquired an assortment of window glass ranging from thin residential glass to 1/4-inch (6.35 millimeters) thick standard commercial plate glass and 1/4-inch thick low-iron plate glass. They then photographed a subject through each piece of glass using the Canon 600mm f/4 telephoto lens and afterwards scrutinized the images. The quality of all images was good with the grade of glass making no observable difference. Using a lens resolution chart with controlled lighting probably would reveal a quality difference. It is possible also that photographing through the glass samples using a large aperture Schmidt-Cassegrain telescope would produce an observable difference (refer back to 6-38). Some types of glass, of course, demand replacement or a change of vantage point (e.g., inexpensive wavy glass, multipane windows, textured glass (image abstraction), and plastic glazing. When photographing through glass, the glass must be clean and free of reflections.

consider using live view to observe the subject on a computer screen rather than viewing through the camera viewfinder. A manual-geared head or a heavy-duty pan/tilt base with workstation controls can support the SCT. High-magnification photography from a vehicle often requires stabilizing the vehicle because even moderate winds cause objectionable vehicle movement. Scissor jacks supporting the vehicle frame at four points is effective and commercial leveling systems exist that are worth investigating.

If budget is a concern, purchase a used camper, or purchase a new utility version. The utility version is a camper without a galley, refrigerator, or closets, leaving one free to furnish it according to need and preference. Six-Pac® Campers, located in California (USA), offers an 8 foot (2.44 meters) slide-in cab-over utility model that is considerably lighter and less expensive than furnished campers are. The website of Six-Pac Campers describes their Six-Pac Utility model as follows:

> The Six-Pac Utility is a spacious, versatile "working camper," designed to earn its keep on any make, model or size truck. The Utility has a sleek, open interior, unencumbered by a galley, refrigerator or closets. . . . And the Utility's lightweight classification makes this a camper you can handle . . . The Six-Pac Utility can be factory customized to suit many of the particular storage and transportation needs of hobbyists and sports and outdoor enthusiasts with specific requirements. . . . Long-bed, short-bed or mini-truck configuration available. . . (Six-Pac Campers, 2005, n.p., *Utility: Sized to fit all trucks*).

Because utility versions do not include the furnishings that one would remove when configuring the camper for clandestine use, they beg consideration. Utility versions cost less, weigh less, and they eliminate the need to remove unwanted furnishings and fixtures. An 8-foot utility model permits the use of the less expensive half-ton truck although a rear suspension upgrade is desirable (e.g., helper-springs, overload springs, or air bags).

In some instances, in some regions or neighborhoods, an older well-used appearing slide-in cab-over camper on a several year old pickup truck provides good cover. Nobody expects the government to use an old truck and camper, especially a truck with sun-faded paint and rust. In some regions, a new vehicle is more conspicuous than an older vehicle. Always consider appearance from the subject's perspective–match the vehicle to the environment and be sure it appears unofficial. The older of the two authors remembers long ago when unmarked police cars looked like unmarked police cars.

Heating, Ventilating, and Air Conditioning (HVAC) System

Commercial Heating, Ventilating, and Air Conditioning (HVAC) systems made for surveillance vehicles are efficient and effective, but they are expensive. Also expensive is the required battery bank usually consisting of at least two 8D or equivalent batteries, which are large and weigh approximately 74.0 kilograms (163 pounds) each.

Budget is always a concern. If budget is a limiting factor, investigate the less efficient but far less costly 12-volt portable cooling systems. These systems require a battery, but because they do not feature a compressor with a high demand for electricity, a much smaller and less costly battery is sufficient. Two commercial products to consider are the KoolerAire Portable Air Conditioner offered by KoolerAire Incorporated, Montvale, New Jersey (USA), and the Jo Cool offered by Thomas Investigative Publications, Inc., Austin, Texas (USA).

The KoolerAire and Jo Cool systems are chest-cooler (ice chest) based and use ice as a coolant. Placing plastic bottles containing frozen water into the chest-cooler rather than bare ice cubes prevents increasing the level of humidity inside of the vehicle. On hot days, these systems cannot cool the vehicle interior to a comfortable level, but they can make the situation tolerable.

Avoid evaporative cooling systems that cool the air by evaporating water–they are, in effect, a humidifier. (First person note: In Phoenix, Arizona (USA) where I lived for 29 years, we called them swamp coolers). Evaporative coolers do not work well in humid climates and they do not work well inside a surveillance vehicle once the interior of the vehicle becomes humid because of the moisture the cooler puts out. Evaporative cooling systems also place electronic equipment at risk of damage from excessive humidity (e.g., laptop computer, cameras, and camcorders). Canon recommends not subjecting digital single-lens reflex cameras to relative humidity in excess of 85 percent.

Individuals with appropriate fabrication skills can make an efficient cooling system that adds no humidity to the interior of the surveillance vehicle, even though the system is chest-cooler based and uses ice for cooling. The system described here is just one possibility. This system provides chilled air by blowing air across the cooling fins of a heat exchanger through which cold liquid circulates (see Figure 6-44b). The heat exchanger on the cooler featured here is an automotive transmission cooler, which in essence is a small radiator.

The person making an air cooling system such as this must work out fabrication details such as specifically what components to purchase. Fabricate

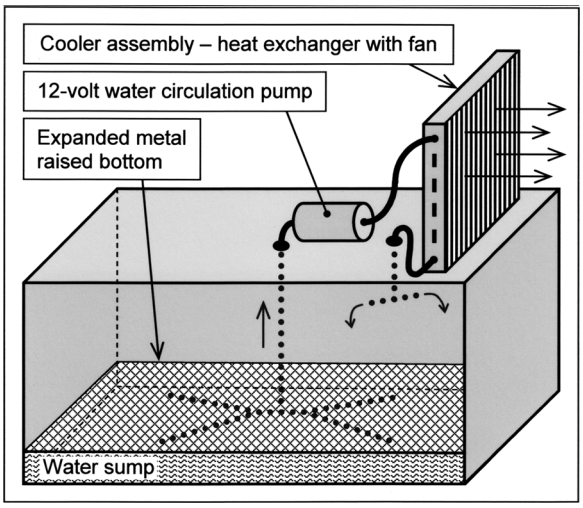

Figure 6-44b. This portable cooling system consists of a large chest-cooler filled with ice, a 12-volt water pump, an automobile transmission oil cooler (heat exchanger), and a suitable size 12-volt fan. The oil cooler is a heat exchanger that transfers thermal energy. Although filled with ice cubes, the bottom of the chest-cooler must contain 5.1-7.6 centimeters (2-3 inches) of water for the pump to draw from. Install an expanded metal or perforated metal raised bottom to create a water sump to keep ice cubes above the intake hoses so that the pump can draw water unimpeded by ice cubes. The 12-volt pump circulates water from the chest-cooler, through the heat exchanger (transmission oil cooler), and back to the chest-cooler. As cold water passes through the heat exchanger, the 12-volt fan blows air across the cooling fins to be chilled. The larger the size of the chest-cooler, the more ice it will contain and the longer it will provide chilled air. Excessive suction in shallow water results in the pump sucking air. By having four points of water intake as illustrated, the three gallons-per-minute pump draws only 0.75 gallons per minute at each point of intake. That permits operating this cooling system with less initial water and more ice, which increases the time that the system provides chilled air. Experiment by placing one or two large frozen blocks of ice into the chest-cooler and filling the remaining space with conventional ice cubes. That may extend cooling time.

this system using a large chest-cooler (e.g., 120-quart (113.56 litre) to as large as 250-quart (236.59 litre).

Caution—never place dry ice into a portable cooling system! Dry ice produces carbon dioxide gas (CO_2) which displaces oxygen, which can be fatal. The New York State Department of Health confirms this, explaining that, "Dry ice can be a very serious hazard in a small space that isn't well-ventilated. As dry ice melts, it turns into carbon dioxide gas. In a small space, this gas can build up. If enough carbon dioxide gas is present, a person can become unconscious, and in some cases, die" (New York State Department of Health, 2005, October, n.p., *What Is Dry Ice?*).

Not all ice is equal–some ice melts faster than other ice does, depending on how cold it is. Ice that is slightly colder than the freezing point of water will melt sooner than ice that is well below the freezing point of water. Begin the surveillance with very cold ice in the cooler! Purchase an ice chest with this in mind.

Individuals doing a lot of photo surveillance from within a vehicle in a hot climate should consider obtaining an ultra-low freezer model generally used in laboratories and pharmacies. Ultra-low models will freeze ice much colder than a household freezer will. For example, the Model C85-14 laboratory chest freezer by So-Low Environmental Equipment Co., Inc., Cincinnati, Ohio (USA), will cool ice to -85° C (-120° F). A similar but less expensive model will cool ice to -45° C (-49° F), this cooler probably the better choice of the two for the application discussed here (i.e., ice-based vehicle cooling systems).

Ice frozen to a lower temperature will provide cooling for a longer time than ice frozen at a higher temperature. In theory, ice can be frozen to absolute zero, the theoretical point at which a substance is at rest and transmitting no thermal energy (0 degrees Kelvin, -273.15 degrees Celsius, -459.67 degrees Fahrenheit). Scientists have not achieved absolute zero artificially.

Ultra-low freezers are expensive, but if one does a lot of stationary surveillance from a vehicle, they are worth investigating, especially if working in a hot climate and the need for a cooling system is frequent.

Various options exist for heating a surveillance vehicle, one inexpensive and easy method being to use a portable propane catalytic heater. Heaters such as the Coleman BlackCat Portable Propane Catalytic Heater are safe for use in enclosed areas. However, ventilation is important because catalytic heaters consume oxygen. The Coleman BlackCat heater provides 3,000 BTUs of heat for up to seven hours when used with a 16.4-ounce (465 grams) nonrefillable propane cylinder.

PHOTOGRAPHING FROM WITHIN BUILDINGS

> Always photograph through clean glass. When cleaning the glass is necessary, cleaning all windows may be required to avoid creating suspicion–a solitary clean window attracts attention. All things must appear normal to onlookers.

In some instances, the surveillance specialist can obtain a hotel room, apartment, condominium, or business suite that provides an unobstructed view of the subject area. Photographing from a suitably located room within a building is especially desirable for a long-term operation. Long term means

several weeks to a year or more. An upper-level room usually provides an unobstructed view of the subject area and it permits photographing from above near ground image-degrading thermals (convection currents). Photographing from above near ground thermals enhances image clarity and it makes extreme distance photography possible.

When photographing from within a building, a number of easily implemented measures contribute to the recording of quality photographic images, and they minimize the likelihood of detection (see Figure 6-45). The measures include, but are not limited to, the following:

- Darken the room.
- Minimize movement and sound.
- Position the camera and/or camcorder a reasonable distance from the window.
- Camouflage the photographic equipment if necessary.
- Place items near the window to create visual disruption and to restrict outsider's view into the room, items such as plants and miscellaneous window decor. Do not use items in a way that attracts unwanted attention.
- Use flat black supplemental curtains as necessary to minimize light reflection on the interior surface of the window glass and to prevent detection by people outside the room. Use auxiliary stands to support the curtains.
- To the extent possible, the glass should be perpendicular to the axis of the lens; avoid photographing through glass at an angle greater than necessary. When possible, select a room location accordingly.

During summer months, photographing through a fully or partially open window is sometimes possible. When photographing through glass, avoid photographing through more than one pane of glass and do not photograph through a window screen. When using high-magnification optics, better image quality results when photographing through thick commercial plate glass rather than thin residential glass, although photographing through the latter with good results is possible. When photographing through glass, use as small a diameter telephoto lens as possible, the reason for this discussed earlier. For a long-term operation, consider replacing low-quality residential window glass with high-quality commercial plate glass if increased image quality is necessary and circumstances permit switching glass. When switching glass, consider low-iron glare-free glass.

If the nature of a long-term operation is such that replacing glass for enhanced clarity is desirable, research the topic because a number of prod-

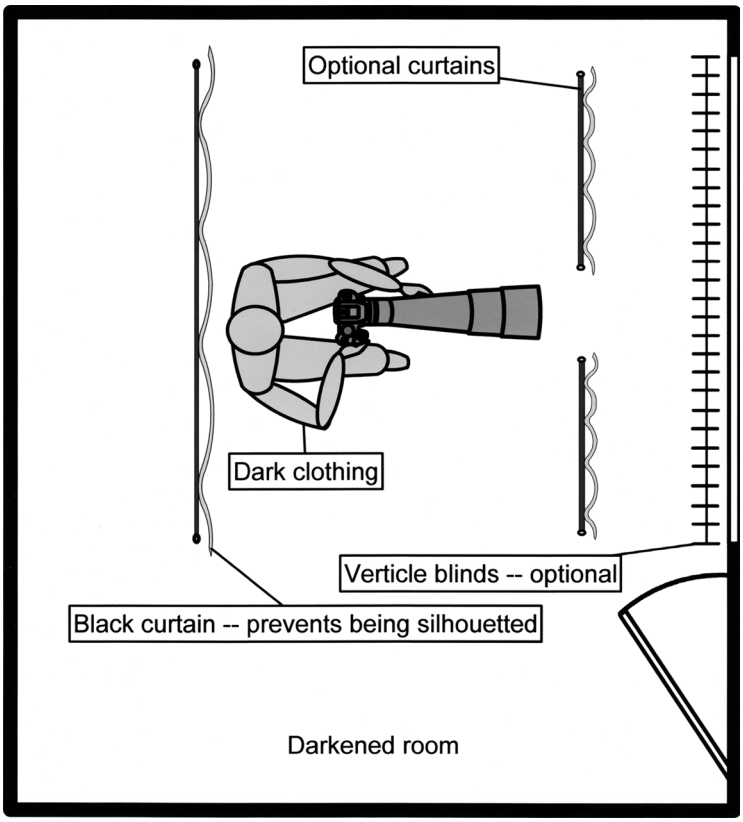

Figure 6-45. Upper level rooms in buildings are effective photographic vantage points. Every situation is different so be creative when implementing measures to avoid detection by people outside the building. The flat black curtain behind the surveillance specialist prevents him being a silhouette against the window and light colored wall surface. An adjustable photography-studio background hangar, also called a background support system, provides a quick and easy way to erect blackout curtains.

uct options exist. Consider the type of glass most appropriate under the circumstances and consider availability of the glass. For example, Starphire® Ultra-Clear Glass by PPG, stocked regionally, is available in a variety of thicknesses. The low-iron formula of the glass results in excellent light and color transmission, and clarity. Most situations do not require replacing window glass, but be aware of the option.

Hanging blackout curtains in a room for purposes of concealment, and to minimize light reflections on the interior surface of window glass requires using suitable support stands. An adjustable photography-studio background hangar, also called a background support or background stand, offers a quick

and easy way to erect blackout curtains inside a structure such as hotel room or condominium.

Background hangars are lightweight and collapsible for easy transport in a travel case. Some crossbars consist of sections that fit together and some are telescoping. Telescoping crossbars offer ease of use and versatility. Although background hangars are available in kit form, those who have light stands can use them to support a crossbar (backdrop pole) made for use with light stands. Pro-duty background support systems cost more than economy systems but the additional cost is justified when considering ease of use and durability.

A SINGLE OPERATION, MULTIPLE SURVEILLANCE METHODS

The tendency is to think of surveillance as being either stationary or moving. Similarly, the tendency is to think that moving surveillance is either by vehicle, public transportation, or by foot. The fact is that many surveillance operations consist of several types of surveillance simultaneously and/or in succession.

With few exceptions, moving surveillance begins with stationary surveillance while the surveillance specialist waits for the subject to appear and begin a commute. Once the subject begins moving, the stationary surveillance becomes a moving surveillance and remains so until the subject reaches an interim or final destination. When a subject traveling by vehicle reaches an interim or final destination, the moving surveillance becomes either stationary or foot surveillance, or both. One surveillance specialist may remain to watch the subject's vehicle while the other follows the subject on foot.

Some surveillance operations consist almost entirely of simultaneous moving and stationary surveillance. For example, one surveillance team watches the subject's residence while another team watches the subject's place of employment. A third team follows the subject while a fourth team may follow the subject's spouse or associate. Finally, some surveillance operations involve both urban and rural surveillance. An example is a subject who lives in a rural area but works in an urban area or frequently visits an urban area.

It happens when moving vehicle surveillance transitions to foot surveillance that the surveillance specialist at some point loses the subject. When that occurs, return to the subject's vehicle and wait for his or her return.

PHOTOGRAPHY AND COUNTERINTELLIGENCE

> There is no fixed procedure that could be recommended for treatment of an espionage investigation. . . . Obtain photographs of the place, if required, provide a series of photographs to give the maximum amount of useful information and to help the reviewer to understand what had happened. (School of the Americas, n.d., p. 145, *Study Manual*)

> There are times when a single photograph is the documentary evidence upon which a critical decision must be based. . . . The specially skilled personnel of a photographic intelligence center may spend days and sometimes weeks . . . extracting information that could not be imagined to reside in it [a photograph]. It may yield only one required fact, but sometimes that tiny piece . . . becomes the key to a cabinet full of hitherto inaccessible secrets. (Bofrone, K. E., 1993, September 22, n.p.)

Introduction

Counterintelligence is a function of intelligence. The United States Department of Defense defines counterintelligence as "Information gathered and activities conducted to protect against espionage, other intelligence activities, sabotage, or assassinations conducted by or on behalf of foreign governments or elements thereof, foreign organizations, or foreign persons, or international terrorist activities. Also called CI"[12] (DOD Dictionary of Military and Associated Terms, 2010, April, p. 111, *Counterintelligence*).

One finds an earlier definition of counterintelligence when going back to the period of the Cold War, the mid-1940s to the early 1990s. The precise beginning date of the Cold War remains in dispute. A training manual of the now closed School of the Americas (SOA) includes a definition of counterintelligence that is reasonably consistent with the current United States Department of Defense definition provided above. The SOA manual defines counterintelligence as, "the activity or activities collectively organized by an intelligence service dedicated to obstruct the enemy's source of information by means of concealment, codes, crypto, censorship and other measures to deceive the enemy by using disinformation, trickery, etc." (School of the Americas, n.d., p. 5–*Study Manual LN324-91*).

Because of the nature of espionage, counterintelligence strategies must include countersurveillance and countersurveillance photography. The United States Department of Defense defines countersurveillance as, "All

12. The initialization CI means *counterintelligence*. Similarly, the initialization CI also refers to a *civilian internee* and it refers to a *confidential informant*. Although the initialization CI has several meanings, context of use, and who uses the initialization prevents confusion.

measures, active or passive, taken to counteract hostile surveillance" (DOD Dictionary of Military and Associated Terms, 2010, April, p. 113, *Counter-surveillance*).

Counterintelligence personnel must understand manual clandestine photography to practice it proficiently without successful intervention by the opposition. Understanding manual clandestine photography is also prerequisite to thwarting the photographic efforts of the opposition.

Key Concepts of Intelligence Photography

> Cameras have a number of applications in the world of security and espionage. Cameras can be used for conducting surveillance. . . . Intelligence personnel have used cameras to photograph individuals and their activities, as well as buildings and installations. A significant subcategory of espionage photography involves the copying of documents, often with special cameras, although sometimes with ordinary equipment. (Knight, 2008, n.p.)

The surveillance specialist must understand how manual clandestine photography contributes to the intelligence collection and analysis process. This overview reveals what is important to the recipients of photographic images if the images are to serve a useful intelligence purpose. Unfortunately, space limitations require that this be only an overview of key concepts. Law enforcement and government intelligence personnel as well as the members of military special operations forces study these issues in depth. The following are important key issues.

- An important activity of intelligence agents and military special operations forces is photographing a specific person, object, activity, or location. Intelligence agents and special operations forces provide imagery intelligence (IMINT) that is otherwise unavailable. As the need for human intelligence (HUMINT) increases, the need for on-the-ground photographic surveillance increases. On-the-ground photographic surveillance is another term for handheld photography, manual photography, and visual photography.
- Intelligence agents and military special operations forces engage in the four types of photography identified below. Although the practitioners engage in four types of photography, they rarely practice each in isolation. While practicing one category of photography, they are simultaneously practicing one or more of the others. For example, when engaged in surveillance photography, the surveillance specialist is often simultaneously doing identification and technical photography. Separation of the four categories of intelligence photography, as done

here, is useful for purposes of analysis and discussion. The four categories of intelligence photography are:

- *Identification photography* pertains to human subjects. The purpose of identification photography is to document subject identity in terms of facial features, clothing, and uniforms and insignias that identify rank and ratings. Identification photography can occur from close range or from a long distance.
- *Surveillance photography* permits documenting information about a specific person, object, activity, or location. Surveillance photography is challenging and therefore it requires a high level of photographic expertise and supporting skills. The surveillance specialist, during surveillance, encounters significant challenges that include, but are not limited to, the following:
  - Adverse and diverse lighting (daytime and nighttime)
  - Adverse atmospheric conditions
  - Adverse weather conditions (e.g., wind and precipitation)
  - Temperature extremes
  - Difficult terrain to negotiate
  - High threat environment
  - Active countersurveillance environment
  - Extreme camera-to-subject distances, 0.80–1.61 kilometer (0.50–1 mile), or more.
  - Very short camera-to-subject distances. Sometimes the need exists to photograph a subject from a limited distance, perhaps 3.048 meters (10 feet) or less.
- *Technical photography* provides the means to acquire information about something without having to capture and transport it. Transporting some subject matter is not possible. In other instances, the adversary must remain unaware that information gathering occurred. The subjects of technical photography include but are not limited to various stationary and mobile equipment such as mechanical equipment, electrical equipment, communications equipment, and security system components.
- *Documentation photography* is common during espionage. Documentation photography is the photographing of the printed word, diagrams and schematics, drawings, and photographic images whether they appear on paper or a computer screen.

- During surveillance photography, when photographing groups of people, the nature of the subjects and mission objectives determine what is important. When photographing unknown subjects, documenting their face and clothing is important. In the case of military uniforms,

important items include insignia depicting rank, rating, and specialty skills. Such things can indicate capability and intensions. When photographing human subjects, recording subject identification is important to document who is present. In all instances, observe and photograph the behavior of all people in the subject's vicinity. A camcorder is useful for this purpose but do not use a camcorder to the exclusion of a high-resolution still camera unless a specific reason exists for omitting still photographs. Two photography teams may be necessary, one team to record moving video images and the other team to record detail using a digital single-lens reflex camera with a high magnification telephoto lens. Mounting a single-image camera and camcorder side-by-side as an integrated unit for operation by one person is an effective method in many instances.

- Panoramic views are often necessary to show a large area. The surveillance specialist can record a panoramic view by using a wide-angle lens, or by using a longer focal length lens and recording several overlapping images. Overlap each image by 30-50 percent horizontally and later stitch them together using a graphics-editing program.
- When photographing property, photograph from wide angle to telephoto. That is, photograph from overview to close up. When photographing human subjects, first record an overview image showing the general area and then record detail using a telephoto lens.
- Record detailed images of utilities-related equipment using a telephoto lens when necessary. Record overview images to identify the location and relationship of objects appearing in close-up views. Record overview and close-up images of items such as, but not limited to, utility poles, transformers, insulators, cables, generators, and above ground fuel tanks. Make an effort to include something of known size in the field-of-view to facilitate scaling other items. The photo analyst needs to know the camera-to-subject distance, make and model of the camera, and the make, model, and focal length of the lens.
- Photographing from an elevated position usually provides a good perspective of the subject and it permits photographing from above image degrading near ground thermals (refer to Figure 7-1 in Chapter 7). An elevated vantage point increases image clarity and it permits photographing from a greater distance. Unfortunately, an elevated camera position eliminates the ability to photograph the under side of aircraft and land vehicles.
- Tele-converters enable the surveillance specialist to take a shorter focal length lens into the field and still have a high degree of magnification. Smaller lenses, naturally, feature less bulk and weight. Unfortunately,

tele-converter use does result in some loss of image detail, and loss of lens speed. For example, a 300mm telephoto lens with a 2x tele-converter cannot provide the same image detail that a 600mm prime lens provides (refer to Figure 2-17 in Chapter 2).

- Afocal coupling enables the surveillance specialist to take a shorter focal length lens into the field and photograph with higher magnification (refer to Figures 4-34 and 4-35 in Chapter 4).
- Avoid having team members appear in photographs. If the enemy captures the recording medium, they may learn more than they otherwise would. In the case of a covert operation, personnel appearing in the images may serve to identify the sponsor of the operation. Moreover, the images may provide information such as unit capabilities and mission objectives. Additionally, the image file contains information such as the camera and lens used, aperture, shutter speed, time, and date.
- Implement measures to ensure against enemy capture of the images, especially when photographing multiple targets at multiple locations. Should the enemy capture the images they may learn enough or deduce enough to compromise the larger operation that the photography mission supports.
- Some situations favor transmitting digital images to headquarters using wireless data transmission technology.
- The October 1993 United States Navy photographer's mate Nonresident Training Course, *Photography (Basic) NAVEDTRA 14209,* provides instruction regarding the photographing of a seaport. The photographic equipment information in that manual is obsolete but the information appearing in the following list remains valid. When reading the list, think about why such images are important and how the logic applies to other situations. An excerpt from the manual (pp. 6–43 to 6–44), relative to seaports, states that, "Photographs can provide a wealth of information such as trading, harbor depth, and various other activities and capabilities of a port. . . . The following areas should be [photographically] documented." The following items of importance, paraphrased, are:
  - Panoramic view. Record a series of overlapping photographs that provide a panoramic view of the port. When using a camcorder, record the area in segments letting the camera briefly rest motionless on each segment. Avoid a continuous panning motion.
  - Ships in the port. Provide overview photographs and close-up images of all items of importance.

  - Channel markers (buoys) are navigation aids that mark channels, regulate water traffic, and warn of a variety of dangers.
  - Piers.
  - Cranes.
  - Ship repair facilities.
  - Ship building facilities.
  - Restricted areas.
  - Warehouses.
  - Railheads.
  - Tank farms (fuel storage tanks).
  - Port headquarters building.
  - Dry docks.
- Most of the items listed above are things that a person can photograph from a ship as it enters and leaves the port. On page 6-44, the manual cautions to "never sneak around military installations or restricted areas in any port." That is good advice!
- Use high-gloss photographic paper when printing hard copy photographs for intelligence purposes. High-gloss paper shows detail better than semi-gloss and matt finish papers do.
- Between missions, keep all photographic equipment in a state of readiness. That includes ensuring that all rechargeable batteries remain fully charged.
- Before embarking on a manual clandestine photography mission, perform an equipment check using a checklist. The mission suffers when the clandestine photography team arrives at the vantage point without an essential piece of equipment or with depleted batteries.
- The underside of vehicles such as aircraft and land vehicles is usually heavily shadowed; adjust exposure as necessary to record properly exposed images of the underside. Proper exposure of the shadowed underside of vehicles usually results in overexposure of other areas. That is acceptable when the images are in addition to properly exposed images of outer areas. Record properly exposed images and then adjust exposure to record shadow areas. Additionally, shoot to RAW to retain all information.
- When photographing newly developed enemy equipment, complete photographic coverage is important. Engineers find considerable information in an appropriate set of pictures. Record moving video images and high-definition still images. As always, record numerous images. If in doubt, photograph it!
- When photographing equipment from multiple perspectives, include overview images and close-up images. Close-up images show detail

and should include a scale for size reference when possible. If approaching the item is not possible, use a high-magnification telephoto lens to record close-up images. Use a laser rangefinder to determine the exact camera-to-subject distance and document the camera and lens used. With that information, a photo analyst can determine scale. If the situation is time sensitive, two surveillance specialists can work together, one recording overview images while the other records close-up images using a high-magnification telephoto lens. Meantime, a third specialist can record the subject using a camcorder, or setup a tripod-mounted camcorder to run unattended. When feasible, mount a camcorder and digital single-lens reflex camera side-by-side for single person operation. These suggestions provide ideas; operate according to needs and circumstances.

- When photographing equipment and vehicles, whether they are watercraft, aircraft, or land vehicles, attempt to photograph them from eight perspectives (see Figure 6-46).

When two photography teams work together (i.e., a photography team and a videography team), both teams do not always need to be at the same vantage point (observation post). Moreover, too many people at one vantage point can increase the likelihood of detection. Two or more vantage points are sometimes desirable for security reasons; subject discovery of one vantage point leaves the other undetected. Sometimes more than one vantage point is necessary to achieve complete photographic coverage of the subject area.

PHOTOGRAPHY LOG

The surveillance specialist must maintain a photography log, the exact format of which is not important. It is important that the log reflect the identity of the specialist and observer, who or what was photographed, the location of the camera and subject, when photographing occurred, and what photographic equipment was used (see Figure 6-47).

PRETEXTS AND TRAP LINES

Pretexts

The use of pretexts is so important to those practicing the clandestine arts that a national private investigation agency had a training manual devoted

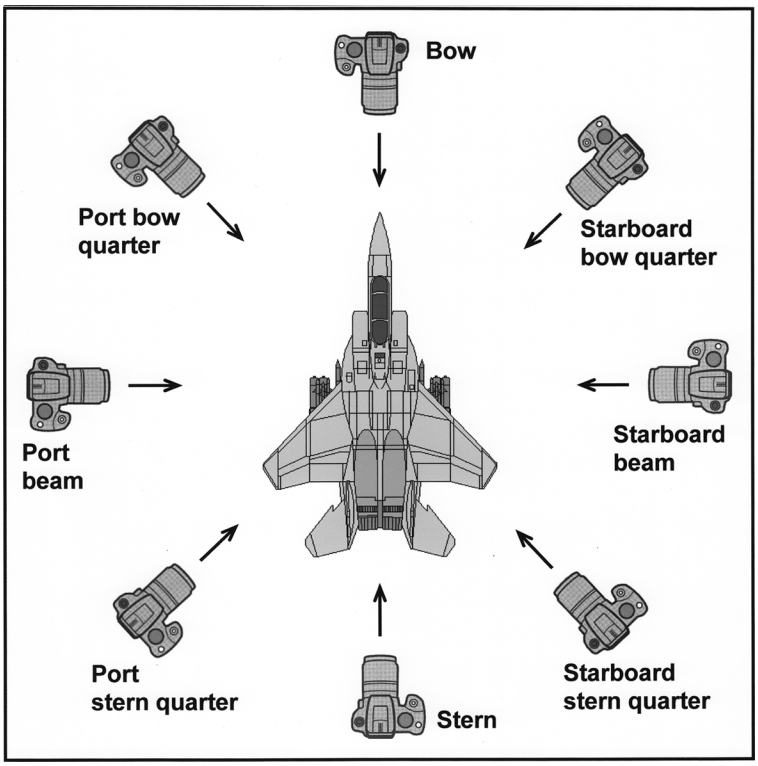

Figure 6-46. Photographs intended for intelligence purposes must contain as much information as possible. Photographing equipment from eight perspectives provides the analyst with considerable information. The two most valuable perspectives are port beam and starboard beam. Those two views work best to determine dimensions. If conditions do not permit photographically recording eight perspectives of the equipment while it sits stationary, wait for it to move if circumstances permit. Photographing the desired perspectives may be possible once the equipment is in use. For example, an aircraft taxiing in preparation for takeoff, or taxiing into position after landing, moves about and thus provides many views. In addition to the photographs, the photo analyst needs to know the camera-to-subject distance and what camera and lens the specialist used.

specifically to pretexts. Pretext possibilities are limitless. Whatever the pretext, research the topic if necessary so that the manner of execution is believable.

Believability is essential to the success of a pretext. Generally, the best pretexts are simple and when well executed and believable, people rarely doubt them. Alleging to be a wildlife photographer is sometimes a good pretext when photographing in rural areas and when photographing from watercraft.

Photography Log—Urban and Rural					
Photographer:		Observer:		Camera:	Lens:
Photo or video #	Date & Time	Subject location (Address and/or GPS coordinates)	Camera location: (Address and/or GPS coordinates)	Camera-to-subject distance (yards/meters)	Compass bearing camera-to-subject
1					
2					
3					
4					
5					
6					

Figure 6-47. A photography log documents pertinent information. When appropriate, when submitting the completed log include an overview photograph of the subject location recorded from the vantage point. Additionally, when appropriate, include an aerial photograph, field sketch, and map excerpt showing the camera and subject locations and all things of importance within the scene. Include a copy of the photography log with the submission of photographic images.

When circumstances are such that people being aware of the photography team's presence is unavoidable, photographing occurs from behind the veil of a suitable pretext (ruse). When using a pretext, people in the photography team's vicinity may be aware that photography is occurring, but they will not know the reason for it. They see the pretext, not the real reason for photography. For example, they see the surveillance specialist and observer taking pictures across a river or small lake and believe them to be wildlife photographers, or recording pictures for a new upstart magazine about water recreation.[13]

When suitable cover exists in a rural area, having a pretext in place is a prudent precautionary measure. Should the subject or an associate of the subject discover the photography team, the pretext will neutralize suspicion. For example, a patch on clothing reading *In-Focus Wildlife Photography Club* supports the pretext of being amateur wildlife photographers. Perhaps, let the subject see a wildlife photography book lying under the tripod; purchase a worn used copy from Amazon.com for this purpose. Additionally, consid-

13. Recently, using a digital single-lens reflex camera with the 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope, a surveillance specialist was photographing a subject on the far side of a lake. Curiosity compelled a man riding by on a bicycle to stop and ask what he was doing. The specialist explained that he was familiarizing himself with a newly acquired telescope before photographing eagles with a friend. The man asked where they intended to photograph eagles. The specialist stated that his friend had a couple of locations in mind, but they had not yet discussed them. Satisfied, the man continued on his way. A believable pretext can be that simple and, usually, the simpler the pretext the better it works.

er having a printed flyer announcing an upcoming members-only wildlife photo contest. A club membership card, fictitious club website, and a telephone number to a trap line should support the pretext. Be imaginative and creative because pretext possibilities are limitless, and they work.

Club patches intended for camouflage clothing serve best embroidered onto subdued color material using a contrasting but subdued color thread. When styling a patch to support a pretext, keep it simple and avoid a law enforcement or military flavor. Consider having an embroidered image of a bird, mammal, or camera on the patch. In addition to a club patch, a name patch will make the photographer's pretext name believable. Avoid styling the personal name patch to look like the nametapes on military clothing.

Previously stated, construct a fictitious website to support a pretext when that is necessary. A person with appropriate computer skills can construct a website within a day or two. The organization name, of course, is fictitious–the organization does not exist. The telephone number on a pretext identification card, stationary, and fictitious website goes to a *trap line,* a trap line also called a *pretext telephone line,* trap lines discussed under the next subheading.

Believability is essential to the success of a pretext. Generally, the best pretexts are simple and if they are well executed and believable, people rarely doubt them. Do not use a pretext that requires specialized knowledge and skill unless actually having the requisite knowledge and skill. One private investigator, to justify lingering in an area during short-term physical surveillance, periodically pretended to be a surveyor. He was able to execute the pretext because he was a surveyor prior to becoming a private investigator. He had the necessary knowledge to support the pretext and he set up using appropriate props (e.g., surveyor's transit, orange vest, hardhat, two-way radio, and a clipboard with an appropriate pretext form). He executed the pretext in a manner that left him believable.

Sometimes a pretext is spontaneous, not preplanned. A private investigator parked his car in a shopping center parking lot to observe a subject on neighboring property. A security officer working for the shopping center became suspicious and inquired what he was doing. The investigator, seeing the security officer approaching, inserted a sheet of paper into the clipboard and picked up a calculator. When the officer asked what he was doing, the investigator stopped using the calculator, smiled and greeted the officer, and explained that he represented a parking lot striping and maintenance company and was preparing a bid to do some minor parking lot maintenance. Satisfied, the guard walked away.

When positioning a surveillance vehicle for a reasonably extended stakeout in an active countersurveillance environment, using a pretext is some-

times necessary. The pretext can be simple. For example, an older male or female investigator parks the surveillance vehicle and alights leaving a second specialist concealed in the vehicle. The investigator walks away wearing an orthopedic leg brace and/or walking with a cane.[14] Depending on location, the driver can enter a retail store or some other business. He or she subsequently leaves the area with what appears to onlookers to be a friend. Later, when retrieving the surveillance vehicle, the person with whom the specialist left drops him or her off at the vehicle. They bid farewell with each person driving away in their respective vehicle.

Here is another example of a pretext used to park a surveillance vehicle without generating suspicion on the part of a wary subject or his or her lookouts. A woman parks the vehicle, exits, and then walks around to the passenger side and opens the rear door. She removes a baby stroller and then removes a baby and places it in the stroller. Then, she walks away pushing the stroller. As a prop, she uses a baby doll so real looking it withstands brief scrutiny even from a short distance. Such dolls are available and affordable and even breathing models are available. By properly using the baby blanket, she permits people to see that she has a baby, but she provides no opportunity for prolonged scrutiny of the baby. With the pretext properly executed, the subject is unlikely to regard her or the vehicle with suspicion. The surveillance specialist remains in the backseat area of what then appears to be an unoccupied parked vehicle. Stated earlier, be imaginative and creative because pretext possibilities are limitless, and they work.

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14. In Chapter 4, a footnote stated that, "Whenever possible, those in the investigative and intelligence fields should exploit the advantages that age bias and attractiveness bias make possible." Exploit also that fact that bias exists relative to people with disabilities. There is an unfortunate tendency to minimize disabled people and assume they do not or cannot occupy certain professions. Years ago, the older of the two authors was dining with a friend in a hospital cafeteria. A man dressed in white walked by with a tray of food and the author's first thought was, "Is he a doctor?" Then, noticing that the individual walked with a limp, he thought, "No, he's not a doctor, he is disabled." Just as quickly he realized the absurdity of that fleeting thought and stated to his friend, "You will not believe what I just did. I assumed that man was not a doctor because he walked with a limp. A disability has nothing to do with qualification to be a doctor." The friend replied, "I did the same thing!" The point is that a wary subject fearing that he or she is the target of an investigation will tend to assume that a disabled (or old) person alighting from a vehicle is not an investigator. When appropriate, fashion a pretext that exploits human bias and the tendency by many people to embrace irrational assumptions about other people based on outward appearance and stereotypes. Accomplish that by understanding people–understand people by understanding yourself. During the late 1800s, the Laestadian revival preacher Juhani Raattamaa (1811–1899) exhibited such impressive insight when counseling congregants that people began to wonder if he was clairvoyant. When asked about that, he explained that he was not clairvoyant but that he understood people because he understood himself.

Trap Line–Pretext Telephone Line

A *trap line,* also referred to as a *pretext telephone line,* is an unpublished or otherwise untraceable telephone number in a name other than that of the surveillance specialist, business, or agency. The telephone number is *only* for pretext purposes. When providing a telephone number is necessary during the execution of a pretext, the surveillance specialist provides the trap line number.

Generally, providing a telephone number during execution of a pretext is necessary when the subject wants to call the organization of alleged affiliation to verify authenticity. Providing a telephone number is also necessary when somebody is willing to provide information but providing it later by telephone is necessary.

The person responsible for answering incoming trap line calls will know what fictitious name and pretext the surveillance specialist is using at the time. When answering an incoming trap line call, the person answers by stating the last four digits of the telephone number. If the caller asks whom they have reached, they are asked whom they were calling. Usually the caller will state the surveillance specialist's pretext name or the name of the pretext organization or company.

The person responsible for answering incoming trap line calls should always pause a moment before answering the telephone. Pause a moment to guard against instinctively answering by the true name of the organization rather than by the last four digits of the telephone number. Pausing is important because people are creatures of habit and can unthinkingly answer the telephone in the customary manner. As a precaution, locate the trap line telephone where background noises will not reveal the true nature of the organization or contradict the alleged nature of the fictitious organization.

Trap line numbers can and do suffer compromise. If any of the following situations occur, they evidence a compromise–immediately obtain a new trap line number. Also, promptly notify the investigator of the compromise because he or she may be in danger.

- Someone calls the trap line number and asks for a surveillance specialist by their real name.
- Someone calls the trap line number and asks if they have reached the true organization.
- Someone calls the real organization number and asks for the surveillance specialist by his or her pretext name.
- Someone calls the real organization number and asks about the pretext company.

AERIAL RECONNAISSANCE AND PHOTOGRAPHY

> The primary purpose of aerial photography is to "document locations, activities, and geographical relationships using aircraft as a platform" (*Forensic Science Communications,* 2002, April, *Vol. 4,* No. 2, 2002, April, n.p., *Aerial Photography SOP*)

Introduction

Planning prior to infiltration sometimes requires aerial reconnaissance and photography (see Figure 6-48). While this is sometimes useful in urban areas, it is more often necessary in rural and semirural areas. Aerial reconnaissance can be accomplished using conventional aircraft or using unmanned aerial vehicles (UAV). Aerial photography services have cameras mounted to the aircraft and they used gyrostabilized manned equipment. Nevertheless, good results are possible using a handheld digital single-lens reflex camera with an image-stabilized lens. In some instances, recording with a camcorder is also desirable.

Conventional Aircraft

> The authors use Cessna aircraft because the side windows open a few inches and it is a high wing aircraft. They find both preferable for handheld aerial photography.

When photographing from an airplane using a handheld single-image camera or camcorder, an ultraviolet haze (UV Haze) filter on the camera lens usually results in better image quality. Some surveillance specialists use a polarizing filter. A filter on the lens also protects the front element against wind driven dirt when photographing through an open aircraft window.

A digital single-lens reflex camera with a short image stabilized zoom lens works well for recording high-resolution aerial images. To record aerial photographs, the authors use a Canon digital single-lens reflex full-frame camera and Canon EF 24-105mm f/4L IS USM zoom lens (see Figures 6-49 and 6-50).

This is an important point. After identifying potential routes to and from potential vantage points using maps and aerial photographs, somebody must travel each potential route to verify feasibility. Traveling the routes in advance is essential because, while a map and aerial photograph may suggest feasibility, obstacles may exist. Russia learned this the hard way during the 1939-1940 Winter War with Finland. The "Soviet objective to cut Finland in half across the Oulu region–while appearing reasonable on a map, this was

Figure 6-48. During aerial reconnaissance, this surveillance specialist uses the a Canon digital single-lens reflex full-frame camera with the Canon EF 24-105mm f/4L IS USM zoom lens. He finds the zoom range of that image-stabilized lens ideal for photography from the altitudes at which he usually photographs. Photograph by Richard Trombley.

inherently unrealistic, as the region was mostly forested marshland, with its road network consisting mainly of logging trails. Mechanized divisions had to rely on these, becoming easy targets for the mobile Finnish ski troops" (Wikimedia Foundation, Inc., 2010, March 11, n.p., *Battle of Suomussalmi*). Reliance on maps to the exclusion of aerial photographs and ground reconnaissance led to a flawed plan.

Unmanned Aerial Vehicles (UAV)

> The Draganflyer X6 is a remotely operated, unmanned, miniature helicopter designed to carry wireless video cameras and still cameras. (Draganfly Innovations Inc., 2010, n.p., *Draganflyer X6 Overview*)

Unmanned aerial vehicles (UAV) are useful for a number of applications in support of manual clandestine photography operations. In many instances, for planning purposes, recent aerial photographs and moving video

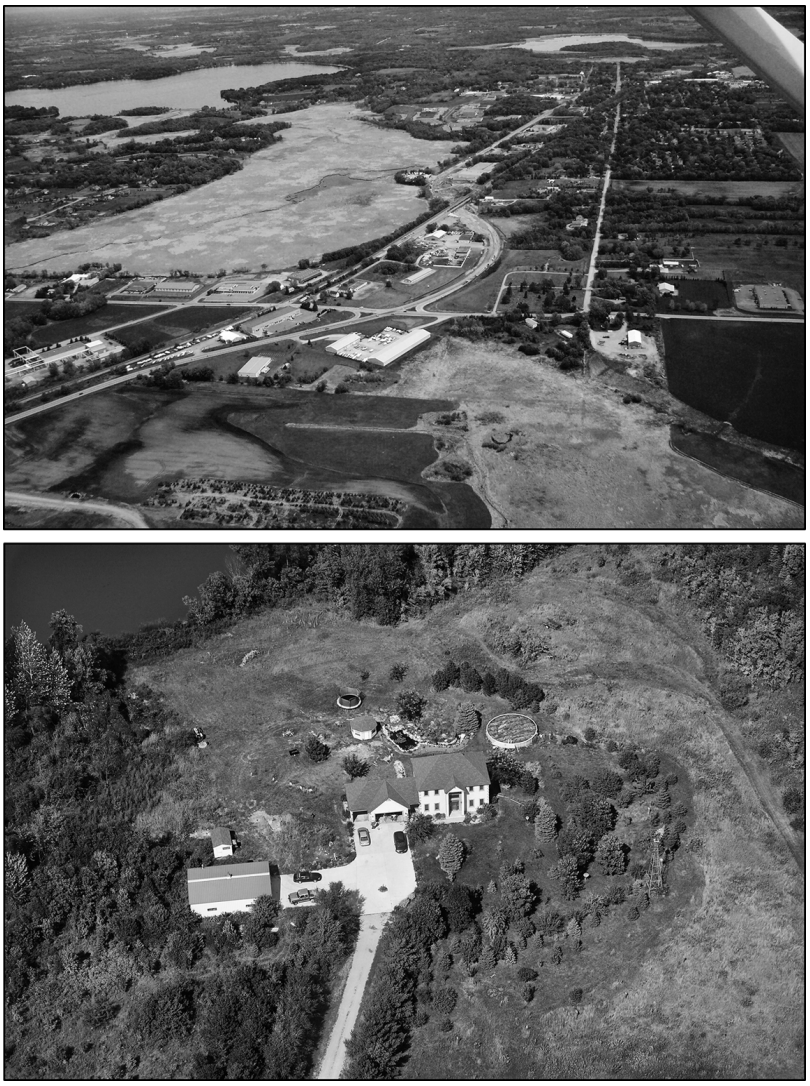

Figure 6-49. During aerial photography, record wide-angle overview and close-up images of the subject area. Select altitude based on desired image detail but fly no lower than other aircraft in the area to avoid arousing suspicion. A single pass flyover is preferable; an airplane circling the area creates suspicion. In some areas, air traffic is limited which can leave a subject suspicious of small aircraft passing overhead at low altitude, especially if the aircraft makes more than one pass. In other areas, air traffic is sufficiently heavy to neutralize suspicion, especially if altitude is consistent with that of other aircraft. The surveillance specialist recorded these images from an altitude of approximately 305 meters (1,000 feet) using the Canon EOS 5D digital single-lens reflex full-frame camera and Canon EF 24-105mm f/4L IS USM zoom lens. The specialist recorded the upper image at 24mm focal length and the lower image at 105mm focal length. Images recorded though the open side window of a Cessna Skyhawk 172 aircraft.

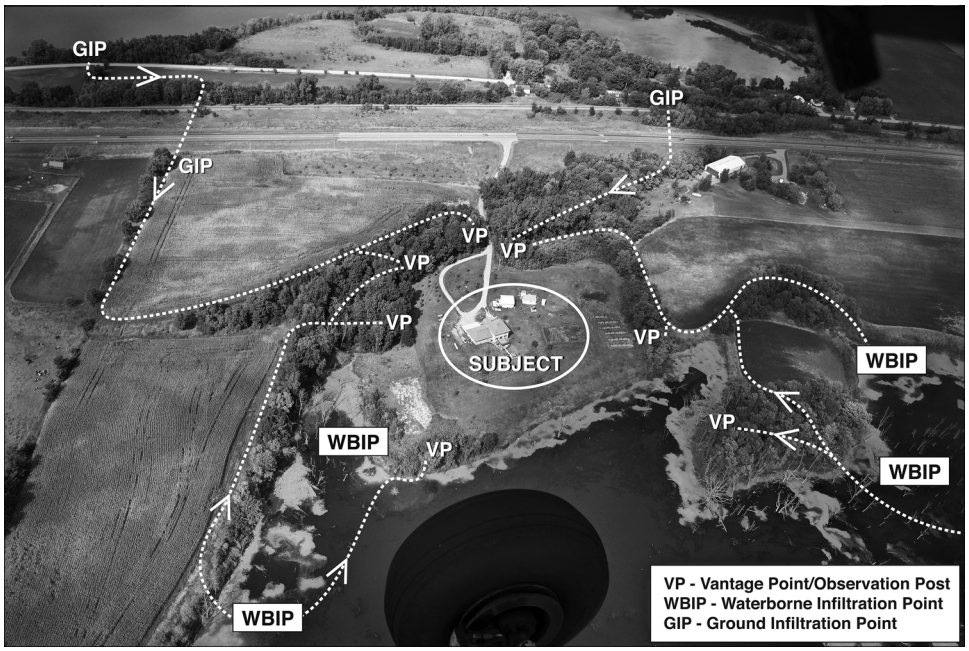

Figure 6-50. In addition to maps, aerial photographs are useful and often essential for route planning. Having identified potential routes, mark them on a map and possibly also on an aerial photograph as done here. Include GPS coordinates if appropriate. *Altitude:* Approximately 305 meters (1,000 feet). *Camera:* Canon EOS 5D digital single-lens reflex full-frame camera. *Lens:* Canon EF 24-105mm f/4L IS USM zoom lens at 28mm. *ISO:* 400. *Aperture:* f/9. *Shutter speed:* 1/250 second. *Aircraft:* Cessna Skyhawk 172, image recorded though the open side window.

images are useful if not essential. When circumstances discourage use of a conventional aircraft, a UAV often provides the necessary images.

Draganfly Innovations Inc. located in Saskatoon, Saskatchewan, Canada, manufactures two unmanned aerial vehicles that merit consideration. They are:

- Draganflyer™ X6 Helicopter
- Draganfly Tango fixed wing aircraft

Introduction to these two unmanned aerial vehicles (UAVs) is brief for two reasons. First, the emphasis of this book is manual clandestine photography. UAVs perform a support role. Second, UAV technology is advancing rapidly. As Dragonfly Innovations Inc. makes advancements to their aircraft this book cannot reflect the upgrades until revision occurs. Readers must visit the manufacturer's website to view current product information.

Figure 6-51. Sporting a high-definition camcorder the Draganflyer X6 Helicopter is a manually controlled or GPS guided platform that accepts Antivibration Camera Mounts. By means of the appropriate camera mount, the operator may use the Draganflyer X6 with a high-definition camcorder, a low-light camcorder, a digital still camera, or a thermal infrared camera (FLIR–Forward Looking InfraRed). *Maximum altitude:* 2,438 meters (8,000 feet). *Cruise speed:* 10 km/h (6 mph). *Endurance:* 20 minutes without payload. *Width:* 91 cm (36 in). *Length:* 85 cm (33 in). *Top diameter:* 99 cm (39 in). *Height:* 25.4 cm (10 in). Image courtesy of Draganfly Innovations Inc.

Figure 6-52. The handheld controller for the Draganflyer X6 Helicopter provides control of the aircraft and camera functions. Image courtesy of Draganfly Innovations Inc.

Figure 6-53. A digital still camera aboard the Draganflyer X6 Helicopter recorded this high-definition photograph. Little imagination is required to anticipate useful applications. Image courtesy of Draganfly Innovations Inc.

For purposes of this discussion, the caption accompanying each illustration provides adequate information (see Figures 6-51 to 6-55). For additional information and for current information, readers are encouraged to visit the manufacturer's website (www.draganfly.com).

In a remote area, a UAV can conduct periodic aerial reconnaissance of the vicinity surrounding a vantage point to ensure it is free of adversary personnel. Similarly, should the subject discover the surveillance or suspect its existence and deploy reaction forces, a UAV can monitor their locations to aid intervention, evasion, and escape.

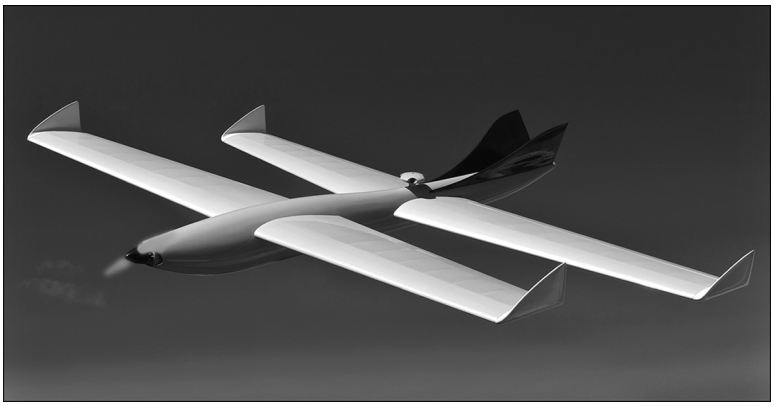

Figure 6-54. The fully customizable DraganFly Tango is a stable unmanned aerial vehicle (UAV) designed for high-definition aerial video or photography, or for thermal infrared (FLIR–Forward Looking InfraRed). This aircraft, controlled manually or capable of autonomous flight by means of GPS, is useful for aerial reconnaissance in circumstances where a conventional aircraft is not feasible. The DraganFly Tango package consists of the Tango airframe, a bungee launching system, and all the flight systems. At an altitude of 91.44 meters (300 feet) or more people cannot audibly detect (hear) the Tango in flight. During flight, at an altitude of 304.8 meters (1,000 feet) the Tango is difficult to see. An autopilot option permits use of the aircraft beyond visual range. *Maximum altitude:* 640 meters (2,100 feet). *Cruise speed:* 50-60 km/h (31-38 mph). *Maximum speed:* 95 km/h (59 mph). *Stall speed:* 35 km/h (21 mph). *Endurance:* 50 minutes. *Length:* 120 centimeters (48 inches). *Wingspan:* 150 centimeters (60 inches). Image courtesy of Draganfly Innovations Inc.

Figure 6-55. This aerial photograph recorded from the DraganFly Tango unmanned aerial vehicle (UAV) attests to the quality of the images the system provides. Image courtesy of Draganfly Innovations Inc.

Chapter 7

ATMOSPHERE, WEATHER, AND MANUAL CLANDESTINE PHOTOGRAPHY

Convection currents, wind, landform induced air turbulence, pollutants in the air, and the elements of the air itself work together to degrade the quality of photographic images recorded from extreme distances. Indeed, modern optics can reach farther than the atmosphere permits.

INTRODUCTION

This chapter discusses the extent that the atmosphere is a limiting factor during extreme distance photography, day and night. The information this chapter provides is important because the atmosphere more than anything else limits the distance from which the surveillance specialist can record images useful for investigative and intelligence purposes. Stated another way, there is a point at which the atmosphere prevents photographing from a greater distance regardless of lens quality, focal length, and the expertise of the surveillance specialist.

The maximum distance from which the surveillance specialist can record usable images depends on the following four factors.

- The amount of detail that photographic images must contain affects maximum camera-to-subject distance. For example, the surveillance specialist can record images identifying military vehicles from a greater distance than he can record images identifying individual people.
- Atmospheric conditions such as convection currents, wind, and landform-induced air turbulence, pollutants in the air, and the elements of the air itself limit maximum camera-to-subject distance.
- Aside from atmospheric limitations, lens magnification and the laws of optics determine maximum camera-to-subject distance.

- The level of ambient illumination affects maximum camera-to-subject distance. Good lighting makes photographing from greater distances possible.

Long-range and especially ultra long-range manual clandestine photography requires a high level of technical expertise. The surveillance specialist must be a skilled photographer and know how to manage difficult variables that challenge the recording of useful photographic images from long distances. The variables include the atmosphere and lighting.

Finally, this chapter discusses how surveillance specialists cope with adverse weather conditions. The surveillance specialist must cope with temperature extremes, inclement weather, and they must prevent dew formation on photographic equipment.

AIR TURBULENCE, POLLUTION, AND LIGHT SCATTER

> Indeed, air is more like a raging river featuring rippling currents and eddies of semi-polluted water than it is a calm pool of clear water.

Air Turbulence

How do military satellites record remarkable photographic detail of activity on the ground? Aside from precision optics and state of the art image sensors, they accomplish that by looking down from above thus avoiding most near ground air turbulence and pollution. Similarly, astronomers photograph upward and thereby avoid most near ground air turbulence and pollution. Moreover, when possible, astronomers photograph from a high elevation vantage point, and they photograph when atmospheric conditions are favorable, when what they call "seeing" is good. Unlike military satellites looking down and astronomers looking up, surveillance specialists photograph along the surface of the Earth, photographing through the worst near-ground air turbulence and pollution that the atmosphere has to offer at the time. That limits maximum camera-to-subject distance and the quality of photographic images.

Many factors challenge the surveillance specialist's ability to record quality photographic images from a long distance, the least of which is the optical performance of the telephoto lens or telescope in use, assuming quality optics. Attesting to the quality of modern optics and confirming that it is other factors including the atmosphere that limit camera-to-subject distance, Ken Rockwell (2008, n.p.) in his discourse titled *Lens Sharpness* explains that:

> Most lens makers' sharpest lenses are their 300mm f/2.8, 400mm f/2.8, 500mm f/4 and 600mm f/4 ED and L series lenses. Look at their MTF graphs, and they really do have virtually perfect performance. Unfortunately, long lenses have even more stacked between them and a sharp picture. Not only do long lenses have paper-thin depths of field, but their biggest barrier to sharpness is our atmosphere! Even at reasonable distances, heat shimmer is so magnified by long tele lenses that it's often a big barrier to sharpness. Fog and haze at long distances doesn't help, either. Long teles are subject to the same things that vex astronomers, which are called "seeing" conditions. . . . A sharp photo needs good lighting, clear air, getting the subjects to sit in the plane of best focus, and an imaginative photographer. Depth-of-field, imperfect focus and subject and camera motion are the major reasons photos are rarely as sharp as they could be. Lens imperfections almost never matter in real photography.

Astronomer's use the term "seeing" to describe the quality of the Earth's atmosphere relative to visual clarity. If conditions favor making quality observations of the heavens using a telescope, astronomers say there is *good seeing*. If atmospheric conditions are unfavorable, astronomers say there is *bad seeing* (KidsAstronomy.com, 2008, n.p.). KidsAstronomy.com? Never think you know so much you cannot learn something from children's books. A cliché of unknown origin states that, "The more I learn, the more I realize I don't know."

Telephoto lenses of 1,000 millimeters or more permit photographing subjects from long distances, distances sufficient to result in problems with the atmosphere. This is true for still cameras and camcorders. When looking through the viewfinder of a camera featuring a high-magnification telephoto lens, one discovers that air is visible and in motion. Indeed, air is more like a raging river featuring rippling currents and eddies of semipolluted water than it is a calm pool of clear water.

Air density is not uniform and neither is it free of pollutants and motion, conditions that challenge those using high-magnification telephoto lenses and telescopes to photograph distant subjects. As Ken Archer (2006, n.p.) explains:

> When using a telescope for daytime, terrestrial observing the distance you can see is limited by the condition of the atmosphere through which you are viewing. High amounts of moisture in the air or heat waves radiating from the ground will give you a blurry image over great distances.

What Archer says applies equally to terrestrial photography using high-magnification telephoto lenses and telescopes. The surveillance specialist does terrestrial (earthly) photography.

Sources of air turbulence include convection currents (thermals), wind, and landform irregularities. Landform irregularities commonly create significant air turbulence on the downwind side because as air passes over and around obstructions it begins to swirl, sometimes erratically. In a discourse titled *Photography Using the Questar Telescope,* Questar Corporation (n.d., p. 7,) recommends keeping "your line of sight as far above the ground as possible, shoot from a hill or the top of a man made structure. Avoid a line of sight that has features that include objects with gross temperature differences from the surrounding air." Confirming the "seeing" problems that obstructions create, EfstonScience (n.d., n.p., *Telescopes with EQ1 & EQ2 mount*) states, "Do not try to observe [or photograph] any object when the light path passes near any protrusion on the ground. Even extremely light winds can cause major air turbulence as they flow over the top of a building or wall."

Air Pollution

Air pollutants to varying degrees interfere with long-range manual clandestine photography, the problem more pronounced in some regions than in others. Seasonal variations also exist.

In addition to being in continual motion and featuring inconsistent density, air contains natural and human-created pollutants that diminish clarity. Impurities in the air also scatter light. Writing to the title *Air pollution, The Columbia Encyclopedia,* Sixth Edition (2005, n.p.), explains that, "The air . . . carries many kinds of dust, of meteoric as well as terrestrial origin, and microorganisms, pollen, salt particles, and various gaseous and solid impurities resulting from human activity." It further reports that air pollution results from vehicle emissions, power-generating stations, industrial emissions, and the burning of solid waste. Air pollutants, to varying degrees, interfere with long-range manual clandestine photography, the problem more pronounced in some regions than in others. Seasonal variations also exist.

In addition to heat waves and pollutants, the constituents of the atmosphere (air) itself to varying degrees impair visibility and degrade the quality of long-range photographic images. Air consists of "nitrogen, oxygen, argon, water vapor, carbon dioxide, and small amounts of other gases and solid and liquid particles" (*Compton's Encyclopedia & Fact-Index,* 1997, p. 748, *Atmosphere*).

Light Scatter

Mist and fog consists of water droplets and has much the same effect on photographic images as atmospheric haze. Photographers cannot eliminate the image degrading effects of mist and fog by the use of filters.

Air contains fine particles that to varying degrees cause light to scatter, scattering in all directions. Scattering is the result of particles in the air reflecting and absorbing light. Fog, dust, and other impurities in the air cause light scattering.

Ultraviolet and blue light frequencies, being on the short end of the light (electromagnetic) spectrum, are scattered more by impurities in the air than are longer wavelength light rays. One can minimize the image degrading effects of light scatter by photographing through an ultraviolet (UV) haze filter or skylight filter, although they are only marginally necessary when using a digital camera. UV haze filters and skylight filters are less essential with digital cameras because the image sensor (CCD, CMOS, or Live MOS) of digital cameras are affected less by the scattering of ultraviolet and blue frequencies (light rays) than photographic film is.

Although UV haze filters and skylight filters are only marginally necessary when using digital cameras, many photographers place such filters on their lenses to protect the front element against dust and physical damage. Conversely, some photographers do not use UV haze or skylight filters. They avoid using such filters, feeling that the detriments outweigh the benefits. They feel that adding an additional piece of glass (filter) to the lens system degrades image quality, even if only marginally.

When photographing from a considerable distance using a high-magnification telephoto lens or telescope, side lighting somewhat from the front of the subject is preferable to direct frontal or back lighting. That is because backlighting features severe light scattering and the subject is a silhouette, and direct frontal lighting tends to reduce image contrast.

PHOTOGRAPH FROM ABOVE NEAR GROUND THERMALS

A long-range high elevation vantage point often permits recording better photographic images than a short-range low-elevation vantage point. Always seek as high a vantage point as possible, photograph from no farther than necessary, and never use a lens of greater magnification than circumstances require. A long-range photography rule-of-thumb advises to get closer or get high, preferably both!

Photographing from above near ground thermals maximizes image quality and camera-to-subject distance. Air turbulence in the form of thermals, also called heat waves and convection currents, is very active near the surface of the earth but they diminish rapidly with elevation. For that reason, when using a high-magnification lens to photograph a distant subject, seek a vantage point as high above the ground as conditions permit.

When photographing from ground-level, the thermal activity prevents recording important detail from any appreciable distance. Additionally, near ground thermals can make precise focusing difficult and in some instances impossible. In his book *Astrophotography for the Amateur* (1999, p. 85), Michael Covington explains that, "One reason accurate focusing is hard is that, because of air turbulence and diffraction, you're almost always trying to focus an image that is inherently blurry and will not be crystal-clear no matter what you do. . . ."

An elevated vantage point makes focusing possible and it makes recording detail possible from much greater distances. Similarly, if from ground level, the photographer can record important detail such as vehicle number plates (license plates) and subject facial features, an elevated vantage point will provide improved image detail.

It is not possible to emphasize too strongly the importance of an elevated vantage point to avoid image degrading near ground thermals, especially during hot weather. This becomes increasingly important as camera-to-subject distance increases and a higher-magnification lens becomes necessary. To illustrate this, the authors used a high-magnification telephoto lens to photograph a vehicle from a distance of 365.76 meters (400 yards). For this illustrative exercise, the location of the camera and vehicle remained constant except for progressively increasing the elevation of the camera.

Using a Canon 600mm f/4 super telephoto lens with a 2x tele-converter, making the lens 1200mm f/8, the authors photographed a vehicle from three different elevations. First, they photographed the vehicle from ground level, the tripod mounted camera being 1.524 meters (5 feet) above the ground. Then, using a scissor lift to elevate the camera, they photographed the vehicle from a camera height of 5.334 meters (17.5 feet) and again from a camera height of 8.382 meters (27.5 feet). When comparing the images recorded from the three elevations, the benefit of increased camera height becomes apparent (see Figure 7-1).

A long-range telephoto capability results in more vantage point options from which to choose. In the rural environment, high-ground vantage points are sometimes available. In the urban environment, photographing from an upper level of a multistory building often is an option. Another option is photographing from the top of a manmade structure. Whatever the surveillance specialist does to elevate the camera, image quality will be better and maximum camera-to-subject will be greater by virtue of avoiding image degrading near ground thermals. A long-range high-elevation vantage point often permits recording better photographic images than a short-range low-elevation vantage point.

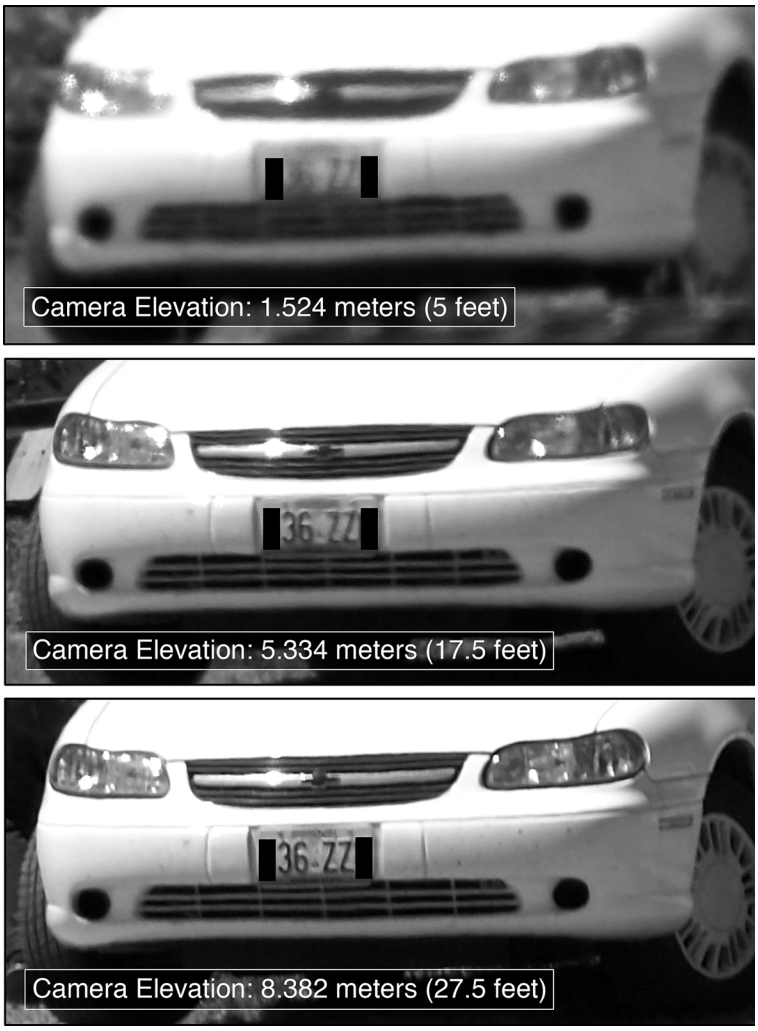

Figure 7-1. Do not underestimate the extent that elevating the camera above near ground thermals improves image quality. The highest quality optics will provide no more than what the atmosphere permits. The surveillance specialist recorded each of these images from 365.76 meters (400 yards), each image being a cropped portion of a larger image. Further increasing camera height would have resulted in progressively better image quality.

In many instances, in both the urban and rural environment, the specialist can achieve camera elevation by using a scissor lift (see Figures 7-2 to 7-4). In the rural environment, camouflaging the lift is usually necessary. In the urban environment, a well-conceived and properly executed pretext can justify the presence of the lift, if a pretext is necessary under the circum-

stances. The lift illustrated here is manufactured and marketed by Portable Lift Equipment, Inc. (PLEINC).[1]

When considering the purchase of the camouflage lift, discuss *cryptic camouflage* needs with the manufacturer, Portable Lift Equipment, Inc.–PLEINC. This is important because visual deception requires appropriate camouflage colors and patterns. For camouflage to work, the colors and pattern must be appropriate for the location and season of intended use. The lift must blend with the predominant colors and character of the background against which a subject views it.

The United States Border Patrol selected the color gray so that the lift and enclosure blends with the sky. Blending with the sky is important because the Border Patrol often locates a lift on high ground to observe a large geographic area. Unfortunately, using the lift in that manner sometimes leaves the apparatus silhouetted against the sky, but that is unavoidable.

A surveillance team using the lift in a localized region may find it necessary to repaint the lift seasonally, or own more than one lift with each camouflaged for a different season. A surveillance team that travels throughout a large region such as the United States must paint the lift according to season and geographic location, or own several lifts, each painted with a different camouflage color and pattern. The United States is large and features many types of terrain and climatic conditions (e.g., desert, swamp, prairie, mountain, woodland, and arctic).

The heavy-duty lift illustrated here, the TP9000, weighs 1,084.09 kilograms (2,390 pounds). When towing the lift, use a vehicle featuring an appropriate tow rating. Realize that towing the lift on established roadways is different than towing it off-road through undeveloped terrain, some such terrain featuring steep hills. Consider not only the vehicle's ability to pull the lift up a steep grade, but also consider the vehicle's ability to holdback the lift when descending a steep grade. Always think safety!

When in need of a working height greater than a scissor lift provides, consider engine-powered and trailer-mounted telescopic boom lifts. Also, consider a telehandler with a fork mounted work platform. Several companies manufacture such products. The company JLG, for example, manufactures telescopic boom lifts with platform heights ranging from 12.19–41.15 meters (40–135 feet). Readers are encouraged to research these products relative to case-specific needs. Rather than owning such equipment, consider renting equipment on an as-needed basis.

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1. Portable Lift Equipment Incorporated (PLEINC). 202 South 19th Street, Beresford, South Dakota (USA) 57004. Telephone: 605.763.2945. Fax: 605.763.2947. Website: www.plelift.com. E-mail: sales@portableliftequipment.com.

Figure 7-2. The authors used this self-leveling TP9000 mobile trailer scissor lift to record the images appearing in the previous illustration. During transport, one may tow this lift at highway speeds and once reaching the destination, place it into operation within just a few minutes. Without the outriggers extended, this lift extends to 3.658 meters (12 feet). With the outriggers extended, this lift extends to 6.858 meters (22.5 feet). This lift, manufactured by Portable Lift Equipment Incorporated (PLE Inc.), is sufficiently stable to permit photographing even on moderately windy days without guy-wires. The authors photographed from this lift at maximum height on a gusty day using the Canon EF 600mm f/4L IS USM super telephoto lens with the Canon EF 2x II tele-converter making the lens 1200mm f/8. The wind did not prevent recording quality images, a testimony to the rigidity and quality of this lift. The surveillance specialist can operate the camera as shown or frame and focus the camera and then operate it from a nearby location shooting wirelessly directly to a computer. The specialist can also operate the camera on live feed. Remote operation of the camera is less conspicuous, especially when suitable camouflaging/disguising obscures the camera apparatus. For further information about this and related products, visit the manufacturer's website: www.portableliftequipment .com.

Figure 7-3. Portable Lift Equipment Incorporated (PLE Inc.) offers the portable hunting blind that is useful for some rural applications. During cold weather, one can heat the enclosure using a tent heater or, using an appropriately muffled generator one can electrically heat and cool the enclosure. In some instances, an appropriately muffled all terrain vehicle (ATV) is useful for commuting to and from the vantage point. Image courtesy of Portable Lift Equipment, Inc.

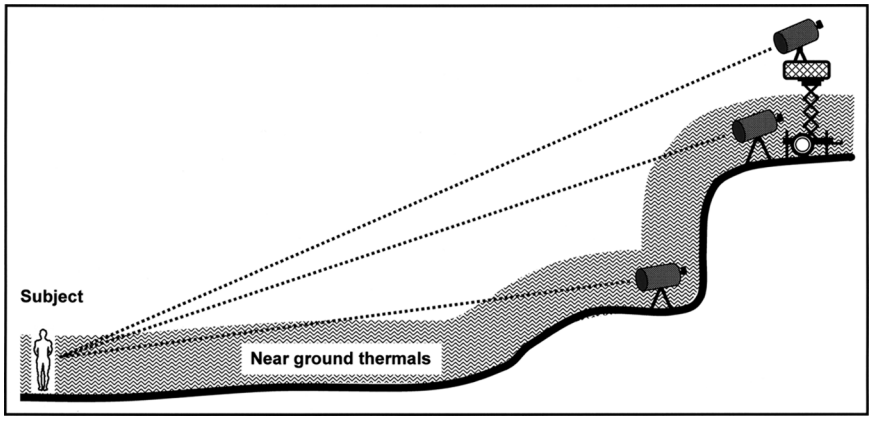

Figure 7-4. An elevated camera location minimizes the effects of image degrading near ground thermals (heat waves / convection currents) which improves image clarity and increases maximum camera-to-subject distance. When located on high ground, further elevating the camera is beneficial because high ground also features near ground thermals. A quality scissor lift makes increased elevation possible. The phenomenon illustrated here applies in both the urban and rural environments whether photographing during daylight hours or photographing at night using an image intensifier night vision device. An elevated subject location provides the same benefit as an elevated camera location. Best results occur when both the camera and subject is elevated.

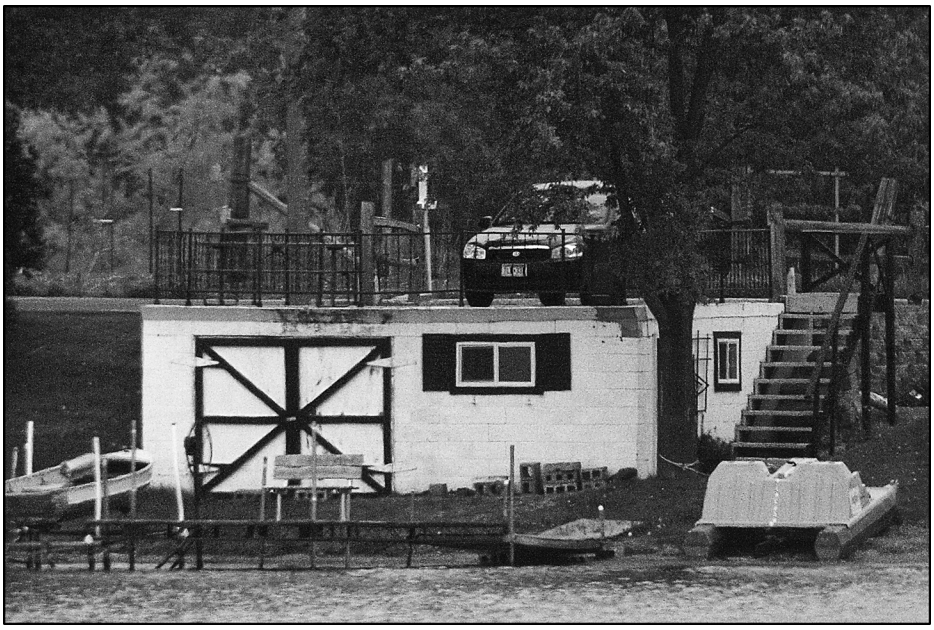

Figure 7-5. Subject property photographed from 1.786 Kilometers (1.11 miles). The camera was approximately 12.192 meters (40 feet) above the water while the vehicle was approximately 3.231 meters (10.6 feet) above the water. Atmospheric conditions were poor. The surveillance specialist recorded this photograph shortly before heavy rain began and the National Weather Service issued tornado warnings for the immediate area. *Camera:* Canon EOS 30D digital single-lens reflex crop-sensor camera. *Lens:* 3048mm f/10 12″ Mead LX90GPS Schmidt-Cassegrain telescope (61x magnification). *ISO:* 250. *Shutter speed:* 1/500 second. *F-ratio (aperture):* f/10. *Method:* Prime-focus (direct coupling).

When circumstances provide both an elevated vantage point and an elevated subject, and when thermal friendly terrain separates the two, recording detail is possible from surprisingly great distances (see Figures 7-5 and 7-6 and refer to Figure 4-20 in Chapter 4).

When reading the remainder of this chapter, keep in mind the discussion and illustrations presented up to this point. The images appearing in Figure 7-1 make it clear that increased camera elevation significantly improves the quality of photographic images. Unfortunately, although increasing elevation significantly reduces the image degrading effects near ground thermal activity, the benefit of increased elevation diminishes as camera-to-subject distance increases. There is a reason for that.

When photographing a relatively nearby subject from a high vantage point, the camera looks down upon the subject at a comparatively steep angle thus avoiding much of the image degrading near ground thermals. As

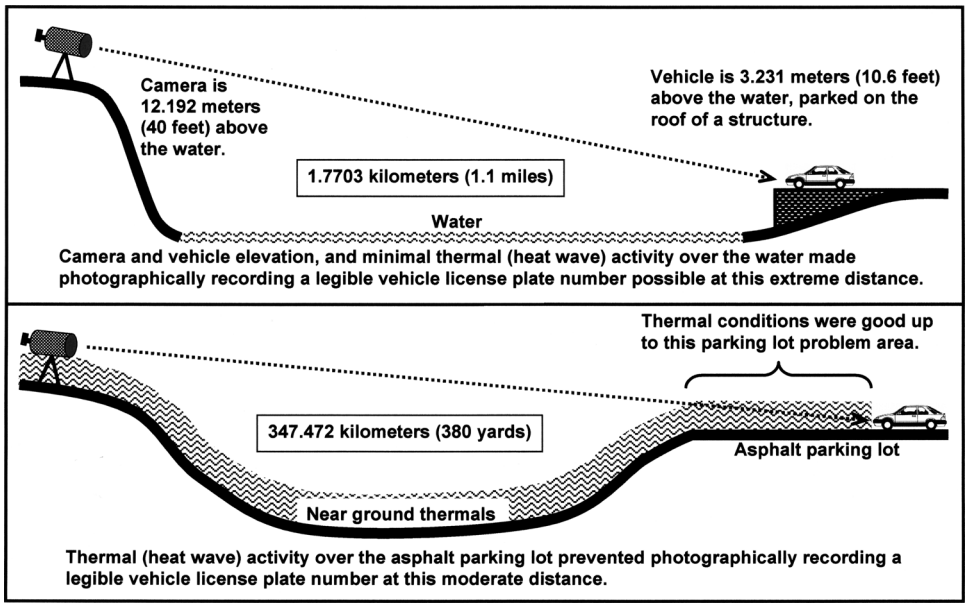

Figure 7-6. *Upper image:* This image shows the camera and vehicle positions relative to the previous illustration. The elevation of the camera and vehicle coupled with minimal thermal activity over water made recording detail from that considerable distance possible. *Lower image:* At this relatively short distance, the surveillance specialist was unable to record a legible vehicle number plate. The camera and vehicle were elevated, which minimized thermal activity for most of the distance. However, the vehicle being on the far side of an asphalt parking lot resulted in a badly degraded image. Thermal activity over the asphalt parking lot surface was severe.

camera-to-subject distance increases, the photographer looks down upon the subject at a progressively diminished angle. For that reason, light traveling from the subject to the camera travels a greater distance through near ground thermals, and the light travels a greater overall distance through the atmosphere before reaching the camera (see Figure 7-7). Always seek as high a vantage point as possible, photograph from no farther than necessary, and never use a lens of greater magnification than circumstances require.

The following is an important point to consider. For understandable reasons, the tendency is to think that ultra-long-range night vision photographs cannot rival the quality of ultra-long-range daytime photographs. While generally that is true, it is not always true because of the numerous variables that affect the quality of images recorded from extreme distances, day and night. Because of variables such as the nature of the illumination, extent of near ground thermals, atmospheric turbulence, air pollution, and thermal friendliness of the terrain between the camera and subject, the quality of some ultra

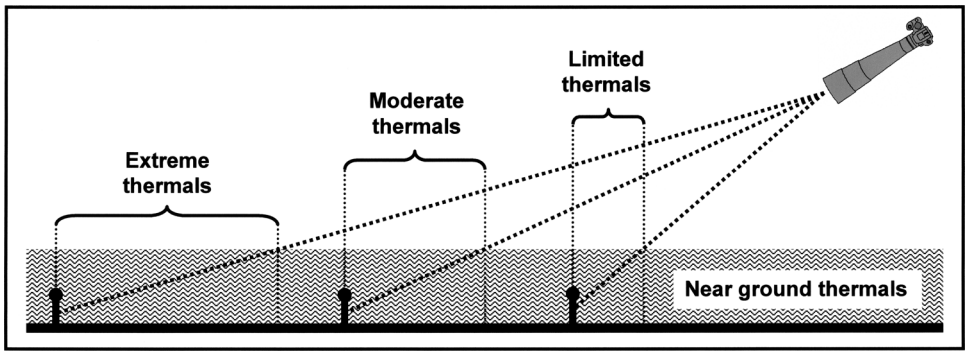

Figure 7-7. Photographing from an elevated vantage point minimizes the effects of image degrading near ground thermals. Nevertheless, the advantage of a high vantage point progressively diminishes as camera-to-subject distance increases. The phenomenon illustrated here applies to both the urban and rural environments whether photographing during the day using daytime optics or photographing at night with an image intensifier night vision device. Never photograph from farther than necessary, although extreme distance is sometimes necessary because of vantage point limitations, a high threat situation, or when working in an active countersurveillance environment.

long-range night vision photographs rival the quality of ultra-long-range daytime photographs (see Figure 7-8).

Near-ground thermal activity is usually a detriment to quality long-range photography and that is why elevation of the camera, or the subject, or both, is so important. Always, to the extent that circumstances permit, avoid photographing through near ground thermals. Near-ground thermal activity exists during the day and at night, although generally thermal activity is greatest during the day. On one occasion, photographing at night using high ISO, photographing from the eleventh floor of a high-rise building to the tenth floor of a second high-rise building 1.21 kilometers (0.75-mile) away, image clarity was sufficient to identify a beverage can; the subject's choice of beverage was discernable. The high elevation of the camera and subject coupled with the cool night air made image clarity from that extreme distance possible.

Discussion up to this point provides the foundation for discussion of the Earth's atmosphere and the effect it has on the results of ultra-long-range photography and videography.

Troposphere

Heat waves are apparent ripples in the air just above the ground, caused by the difference in temperature between hot earth and slightly cooler air

Figure 7-8. In some instances, the quality of ultra-long-range night vision pictures can rival the quality of daytime images recorded from a comparable distance. The surveillance specialist recorded the upper daytime image from a distance of 0.966 kilometer (0.60 mile) and he recorded the lower night vision image from a distance of 0.869 kilometers (0.54 mile). In this instance, the night vision image rivals the daytime image. A number of variables are responsible for that, but the primary reason was the decreased near ground thermal activity when recording the night vision image. The top of the utility pole to the right of the subject is mute testimony of an elevated camera location, and the terrain between the camera and subject was reasonably thermal friendly (i.e., grass and weeds). When recording the daytime image (upper image), on the surveillance specialist's right was an asphalt road that passed to the left of the subject location, meaning that for much of the distance between the vantage point and subject, an asphalt road was producing image-degrading near ground thermals. The camera location was slightly higher than the subject location, but the terrain was not thermal friendly.

> above it. Heat waves can confound any efforts to create a clear photograph of a faraway object low on the horizon. This effect is especially obvious when using high magnification lenses. (Mason, 2010, n.p.)

The troposphere is the lowest portion of Earth's atmosphere. The troposphere "extends from sea level to an altitude of almost 12 miles [19.31 kilometers] above the equator, but only about 5 miles [8.05 kilometers] above the North and South poles" (*The New Book of Knowledge,* 1996, p. 480, *Atmosphere*).

The lowest portion of the troposphere features the *planetary boundary layer* (PBL), also called the *atmospheric boundary layer* (ABL). The planetary boundary layer extends to a height of approximately 1.93 kilometers (1.2 miles), its height affected by landform, time of day, and season.

Cold air is denser than warm air. For that reason, the thickness and therefore the height of the planetary boundary layer is less at night and greater during the day, and less during cool or cold seasons than during summer months.[2]

Contact with Earth's surface affects the behavior of the planetary boundary layer, a layer featuring significant turbulence. The planetary boundary layer is turbulent because of friction with Earth's surface, solar heating resulting in convection currents and convective mixing, and evaporation.

At the lowest extreme of the planetary boundary layer is the thin *surface boundary layer* or, simply, *surface layer, friction layer,* or *ground layer.* This thin layer, closest to Earth's surface, varies in thickness but averages 9.967 meters (32.7 feet).

Because the surface boundary layer is in contact with Earth's surface, convection currents are prevalent and the effects of friction remain almost constant. Hence, air turbulence to varying degrees usually exists. That circumstance presents a challenge for those engaged in long-range manual clandestine photography. Previously stated, it is atmospheric conditions more than the capability of modern lenses that limit the distances from which surveillance specialists can record quality photographic images with a single image camera or camcorder.

Radiation, conduction, and convection working together heat the troposphere. Virtually all weather occurs in the troposphere, and the troposphere contains approximately 75–80 percent of the entire atmospheric mass.

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2. Although convection currents (heat waves) are greater during the day, they do exist at night. Coupling a night vision device (NVD) with a high magnification telescope and using an infrared (IR) illuminator to illuminate a distant subject from the camera location leaves one amazed at the conspicuous movement of the night air. When using an infrared (IR) illuminator for extreme-distance night vision photography, illuminate the subject from a location remote from the camera.

Astronomy 161, University of Tennessee, Department of Physics and Astronomy (n.d., n.p.), reports that, "The troposphere is where all weather takes place; it is the region of rising and falling packets of air."

As the sun heats the Earth's surface, air near the ground expands and gets lighter with cooler heavier air from above descending to force it upward. That occurs in a cyclic manner called a *convection cycle.* It is the downward travel of cool air and upward travel of warm air that creates *convection currents* (thermals / heat waves) characterized by air in motion, air that not only features varying density but oscillating density. The troposphere in which humankind lives is a churning region that often challenges the best efforts of surveillance specialists to photograph subjects from long distances.

MANAGING THE CHALLENGES TO LONG-RANGE PHOTOGRAPHY

Introduction

> When more than one suitable vantage point exists, select that which is most thermal friendly, all else being equal or reasonably so.

Variable air density refracts light just as a lens does, but it does so in an oscillating manner. The oscillating optical properties of air are the result of the small but continuous density changes that turbulence causes, in addition to normal air movement. Light rays traveling the long distance from the subject to the camera fluctuate erratically and produce a distorted image in the camera, an image that appears to dance. The journal article titled *Telescope,* at eNotes.com, Inc. (2008, n.p.), explains that, "The limits to the resolution of a telescope [or telephoto camera lens] are . . . a result of the passage of the light from the distant body through the atmosphere, which is optically non-uniform."

Atmospheric conditions challenge astronomers using telescopes, and frustrate the surveillance specialist using a high-magnification telephoto lens or telescope for extreme distance terrestrial photography. Although the needs of each are different, both the astronomer and terrestrial photographer find similar solutions to the limitations created by the atmosphere. Unfortunately, unlike the astronomer who generally can wait for a clear night and make observations looking upward from high ground, the surveillance specialist must conform to the subject's schedule and location.

Subjects of surveillance do not postpone activity until atmospheric conditions favor photographing them from a long distance. Neither do subjects select a location intended to benefit the surveillance specialist with a camera.

The surveillance specialist must record photographic images at the time and location of the subjects choosing.

Daytime and nighttime atmospheric conditions challenge the surveillance specialist with daytime and nighttime convection currents being a relentless challenge, especially during hot summer months. Convection currents severely limit the distance from which the specialist can record usable photographic images using a high-magnification lens.

Convection currents, as stated, do exist at night. That is one of the reasons why when going active, the infrared (IR) illuminator must be remote from the camera. Using an IR illuminator from the camera location illuminates the atmosphere and obscures the subject, sometimes to the extent that photographing is impossible. The authors had the experience of directing an IR illuminator in the direction of a subject and, with an image intensifier night vision device seeing only what was reminiscent of a river of flowing dirty water. The subject who was 0.80 kilometer (0.5 mile) away was not visible at all.

Minimizing the Effects of Convection Currents

Recording usable photographic images from extreme distances is the result of quality photographic equipment, photographic skill, and opportunity. Nevertheless, opportunity cannot result in usable photographic images in the absence of quality photographic equipment and skill.

The following discussion builds upon previous discussion. There are several ways to minimize the problems caused by convection currents during ultra long-range manual clandestine photography, most methods already identified. The methods are:

- Photograph at a time when convection currents are minimal, when case specific needs permit.
- Minimize camera-to-subject distance to the extent field conditions permit.
- Select a high elevation vantage point, a position above the near ground thermals (convection currents) that are most active within the *surface boundary layer* (surface layer; friction layer; ground layer) that extends upwards from the ground approximately 5-10 meters (17-33 feet). At the very least, occupy a vantage point at least 3 meters (9.84 feet) above the ground, the importance of this minimum elevation discussed shortly.
- Relative to the above, if one locates a high elevation vantage point, but the subject is on low ground, or vice versa, elevation is only a partial solution to the convection current problem. The specialist is pho-

tographing down into near ground convection currents or photographing upward from heavy convection currents. It is ideal when both the photographer and subject occupy an elevated location with low ground between them. In the case of the previously illustrated vehicle photographed from 1.786 Kilometers (1.11 miles), both the photographer and vehicle were on relatively high ground. Moreover, a body of water separated them so conditions were thermal friendly.

- When more than one vantage point option exists, select the one that permits photographing over thermal friendly terrain, all else being equal. Select the vantage point offering a line-of-sight that avoids ground areas and structures that emit heat and/or disrupt airflow.
- Set up early to provide time for the telephoto lens or telescope to achieve thermal equilibrium. This is important for high-magnification refractive lenses and especially so for Schmidt-Cassegrain telescopes (SCTs). In his book *Astrophotography for the Amateur* (1999, p. 171), Michael Covington confirms the importance of thermal equilibrium of the lens. He advises to "Give the telescope a long time for its temperature to equalize with that of the surrounding air." The lens elements and mirrors perform best as an integrated system when each is the same temperature. Expansion rate is not the same for different types of glass, and for glass of different diameters, thickness, and shape. Thermal equilibrium is important but not always achievable such as when outdoor temperature is rapidly changing or when applying heat to prevent dew formation on the optical system.
- Provide shade so the sun cannot shine directly on photographic equipment.
- During an outdoor stakeout, especially at night, implement measures to prevent dew formation on photographic equipment. Use the Astrozap® Dew Controller System designed specifically to keep the temperature of optical systems above the dew point temperature (refer ahead to Figures 7-18 and 7-19). Alternatively, use air-activated chemical hand warmers to keep optical systems above the dew point temperature.

When using elevation to avoid photographing through near ground convection currents (heat waves), it helps to be aware of significant elevations. Although earlier discussion addressed this topic, its importance makes a review desirable. The significant elevations the surveillance specialist must be aware of are:

- 1 kilometer (0.62 mile). The *planetary boundary layer* extends above sea level by as much as 1 kilometer (Majewski, 2007, n.p.). The surveil-

lance specialist usually cannot get above this height. *Note:* The height of the planetary boundary layer, reported here, conflicts with the height reported earlier. The reason is that the height is not uniform by region or time (day, night, and season).

- 30 meters (98.4 feet). The most photographically troublesome atmospheric disturbance occurs within the first 30 meters (98.4 feet) of air above the ground, this issue addressed under the title *Telescopes* by *The New Encyclopedia Britannica,* 15th edition, Volume 28 (2003, p. 506). Sometimes surveillance specialists can get above this elevation (refer to Figure 4-53 in Chapter 4).
- 5–10 meters (17–33 feet). The *surface boundary layer* (surface layer; friction layer; ground layer) extends upwards 5-10 meters (Majewski, 2007, n.p.). Significantly, "typically half to two-thirds of the atmospheric turbulence lies in this ground layer . . ." (Baranec, Lloyd-Hart, & Steward, n.d., n.p.). The surveillance specialist often can locate a vantage point above this level (e.g., a hill, upper floor of a building, on a building, or use a suitable scissor lift or telescopic boom lift).
- 3 meters (9.84 feet). This is an achievable elevation in many instances. The US Army Survival Manual FM 21-76 (1970, October, p. 134) reports that, "if you can get to high ground (3 meters or more . . .), you can get above the superheated air close to the ground and overcome the mirage effect." Prentice-Hall, in their middle-school-level Science Explorer series book, *Weather and Climate* (2007, p. 44), under the title *How Heat Is Transferred,* explains that radiation and conduction heat the ground but, because heat transfers poorly between air particles by means of conduction, only the air within the first few meters above the ground becomes heated by conduction. For this reason, air close to the ground is warmer than the air only a few meters above the ground. The cooler air located just a few meters above the ground features less convection current turbulence.

When more than one suitable vantage point exists, select that which is most thermal friendly, all else being equal or reasonably so (see Figures 7-9 and 7-10). This is an important point. Under the title *Astronomy & Atmosphere: The Effects of Weather and the Atmosphere,* Deepsky Observers Companion (1998, February 12, n.p.) explains that, "Telescope [and camera] surroundings should be 'thermally friendly'–grass is better than pavements; the flatter and more uniform the greenery the better; the higher off the ground, the better."

Air turbulence is severe over an asphalt parking lot and roadway, about as severe as the surveillance specialist will encounter. Air turbulence over a

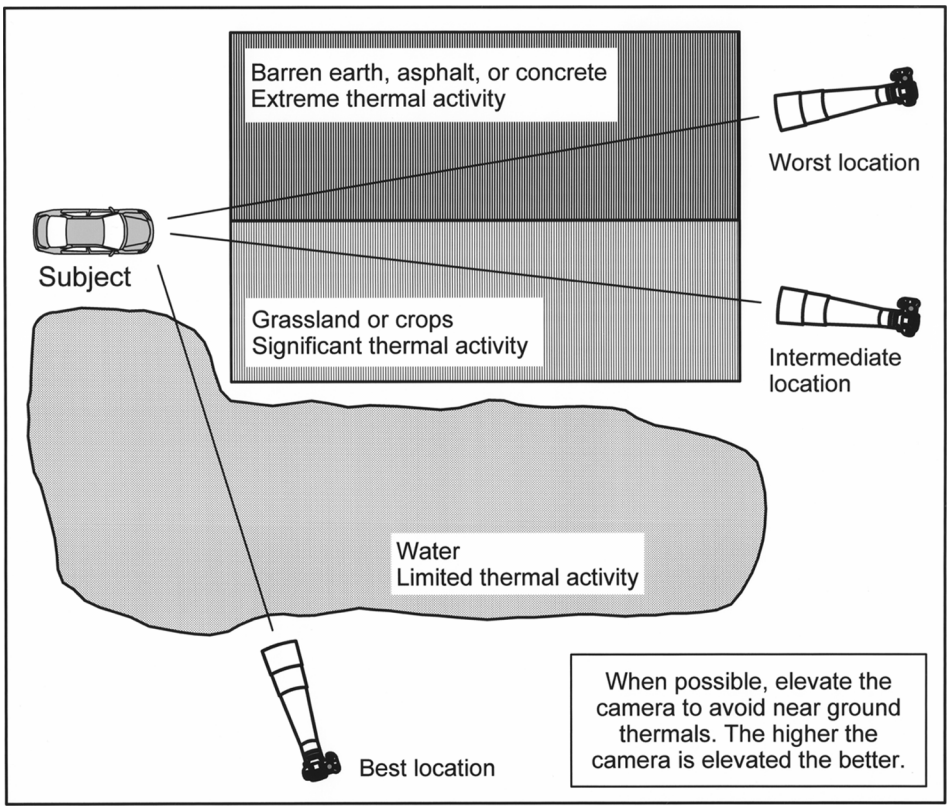

Figure 7-9. When more than one vantage point is available, select the one that permits photographing over thermal friendly terrain. Bodies of water are exceptionally thermal friendly with barren earth, asphalt, and concrete being least thermal friendly.

freshly plowed field is greater than over a field of growing crop. Air turbulence over snow and water is about as limited as one will encounter, although air turbulence over water is generally less than over snow covered ground. As Steven Majewski (2007, n.p.) explains, relative to air turbulence over water, "The atmospheric boundary layer above water generally exhibits smaller thermal fluctuations than over land because the temperature contrast between water and air is generally smaller."

All evidence supports the understanding that, "A lake is very effective in removing the surface layer–water conducts heat well, so a lake is generally the same temperature as the ambient air and convection is suppressed . . . there is no near ground turbulent boundary layer over a lake" (Hill et al., 2006, n.p.).

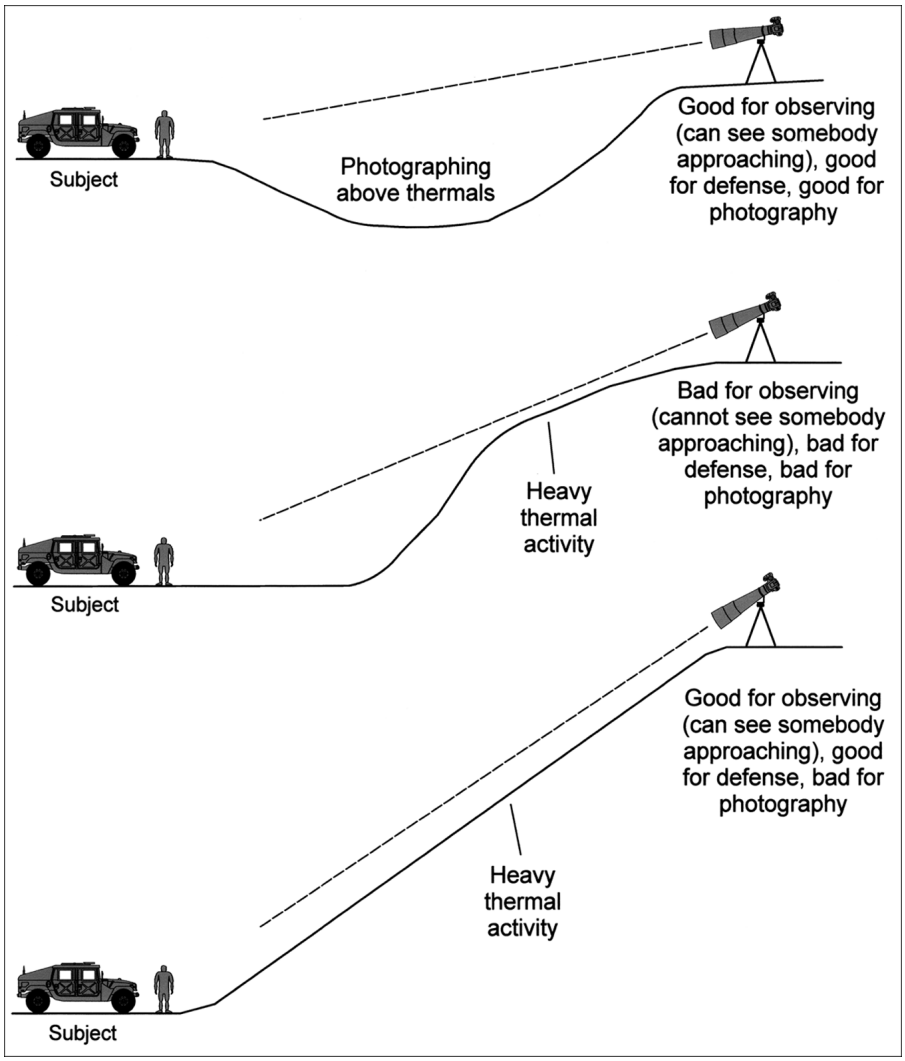

Figure 7-10. When selecting a rural vantage point the surveillance specialist considers many factors, important issues being near ground thermals and safety.

Air turbulence is not as great in the early morning hours before the sun heats the earth's surface so, if possible, record photographic images at that time. Unfortunately, the subject's location and schedule dictates when and from where photographing must occur. The nature photographer and astronomer can often choose their location and wait for the best time to take pictures but the surveillance specialist cannot. The subject's location and schedule dictate when and from where photographing must occur.

Quality Photographic Equipment, Photographer Skill, and Chance

It is the condition of the atmosphere more than the capability of high quality modern optics that limits the distance from which the surveillance specialist can record detail such as a subject's facial features and vehicle number plates. This is true whether using a still camera or camcorder.

When photographing from a long distance using a digital single-lens reflex (DSLR) camera and important activity begins, record numerous sequential images. Alternatively, use a DSLR camera featuring high-definition video capture and record moving video images. Using the 3048mm f/10 12-inch (305mm) Meade LX90GPS Schmidt-Cassegrain telescope (SCT) or its successor the 12″ LX90-SC telescope with a digital single-lens reflex (DSLR) camera by means of the prime-focus (direct coupling) method, surveillance specialists can record images showing subject facial features from distances as great as 1.6093 kilometers (1 mile). From distances exceeding 1.77 kilometers (1.10 miles), they can record legible vehicle number plates.

Although convection currents (thermals) are less over water, they do exist and cause erratically inconsistent air density. Since convection currents leave the density of the air inconsistent, the air refracts light but does so erratically. Because of the erratically inconsistent density of the air, most long-range photographic images are unclear and therefore unusable, but some are clear enough to be usable. This is true also for shorter camera-to-subject distances over land where convection current activity tends to be severe.

During long-range manual clandestine photography, the surveillance specialist records numerous exposures hoping that during a few exposures, the character of the churning air will be just right and result in a usable image. When photographing subjects from a distance of 0.8047 kilometer (0.50 mile) or more, and especially at a camera-to-subject distance of 1.207 kilometers (0.75 mile) or more, many images are not usable. For this reason, when activity of interest begins, record numerous images in rapid succession to increase the likelihood of acquiring a percentage of usable images, images that show important detail. Every so often during the fluctuating density of the air, a moment exists when density is reasonably uniform and recording a usable photographic image is possible.

Acquiring usable photographic images from long camera-to-subject distances is the result of quality photographic equipment, photographer skill, and opportunity (chance). Nevertheless, opportunity cannot provide a usable photographic image in the absence of quality photographic equipment and skill.

Using Videography to Penetrate Atmospheric Turbulence

Recording moving video images at the rate of 30 frames per second results in recording 1,800 frames per minute. Recording that large number of images in a short space of time maximizes the likelihood that many exposures will occur when atmospheric conditions relative to air turbulence are for a fleeting moment favorable.

Image-degrading near-ground thermals and general atmospheric turbulence are a challenge for the surveillance specialist practicing extreme distance photography, day or night. The advice offered elsewhere in this book, relative to near-ground thermals and atmospheric turbulence, is to record numerous sequential images so that some exposures occur when atmospheric conditions are momentarily favorable. Unfortunately, that method leaves to chance that a certain percentage of exposures will occur during a favorable atmospheric moment.

Using the mirror lock-up feature or the "electronic first shutter curtain" feature of a digital single-lens reflex (DSLR) camera, the specialist can record no more than one image every two to three seconds, that method resulting in the recording of 20 or less images per minute. In practice, for example, when using the mirror lock-up feature of a DSLR camera, the specialist depresses the remote release button and the camera mirror assumes the up position. Then, a two-second wait period permits vibrations to subside after which the specialist depresses the remote release button a second time to activate the shutter after which the mirror returns to the down position. The specialist repeats that process again, and again, and again.

An alternative to manually recording sequential images is to record a few minutes of moving video images and then examine them to identify the exposures that occurred when atmospheric conditions were briefly favorable. Writing to this issue, Craig Zerbe (n.d., n.p.), in his dissertation *Video Astronomy,* explains that:

> A video camera has some advantages over film [and digital] cameras. Atmospheric turbulence is the single biggest obstacle to taking high-resolution lunar [and long range terrestrial] images. With a camera you might "click" at just that one great moment of steady seeing (good luck, you're going to need it). With video, you are taking 30 images a second. In 10 minutes, that's 18,000 images.

Recording moving video images to obtain a few usable still images in spite of atmospheric turbulence is a method that works. However, to enhance the effectiveness of this method, try using the image-processing pro-

gram RegiStax to enhance image detail. Although intended for astrophotography, astronomy experts have told the authors that they believe RegiStax has potential for extreme distance terrestrial photography.

RegiStax is a thermal penetrating computer program that processes moving video images for the sole purpose of providing high quality still images. The website of SnapFiles® (n.d., n.p., *RegiStax: Stack Astro Images*) explains that, "RegiStax is an image processing tool that is used to stack (digital) astronomical image captures, in order to improve detail, color and overall quality." RegiStax works with stationary subject matter, not with moving subjects.

Combine an ultra long-range terrestrial videography capability with a thermal penetrating computer program such as RegiStax and the potential for obtaining quality still images of stationary subject matter from extreme distances is considerable. Using RegiStax for extreme distance manual clandestine photography warrants exploration. This is just one example of the sad fact that manual clandestine photography is somewhat in a state of infancy relative to what it is versus what it could and should be; so many potentials beg exploration.

Thermal Equilibrium

> If your telescope has been outside for less than half an hour or if the temperature is changing rapidly, you may want to double check the focus every few minutes. The focus of some telescopes can shift as they cool. (Charles, J. R., 2000, p. 86)

Achieving maximum image quality with a high-magnification telephoto lens or telescope requires permitting the optical system to reach thermal equilibrium. When the temperature of the various lens elements and mirrors are the same, and when their temperature is consistent with the ambient temperature, the lens has reached thermal equilibrium. When setting up a high-magnification telephoto lens or telescope, it requires a cool-down period to achieve thermal equilibrium. Damian Peach (2002, July, n.p.) explains that, "the telescope itself can perturb the image, if it hasn't reached ambient temperature, this will result in a 'boiling effect' when viewing. One should leave their scope [lens] for at least 1 hour prior to observing and probably longer. Also, certain types of telescope[s] . . . are more prone to turbulence . . . if not left to cool for long enough."

Schmidt-Cassegrain telescopes (SCT), especially, require a cool-down period. Once a lens achieves thermal equilibrium and is put into use, honor the advice of Alan MacRobert (2000, n.p.) who, in his article titled *Beating the Seeing,* cautions to "keep your breath and body heat out of the light path" to avoid creating unnecessary and avoidable air turbulence.

Schmidt-Cassegrain telescopes (SCTs) more than many types of optical systems require time to achieve thermal equilibrium. Nevertheless, refractive telephoto camera lenses and refracting telescopes also perform best once achieving thermal equilibrium. Confirming this is the Telescopes and Astronomy (n.d., n.p.) online journal article titled *A Closer Look at Refractors: Achromatic Refractors*. The discourse explains that:

> Apos [apochromatic refractor lenses], because of their sealed tubes and multi-element glass . . . can take longer . . . to adjust to different temperatures when taking them from inside to outside. The different temperature will cause the glass to expand at different rates, which will give a poor image until the glass is the same temperature as outside.

High-magnification refractive telephoto camera lenses feature several optical elements of varying size (diameter, thickness, and shape) and of differing types of glass.[3] The result is, each lens element expands at a different rate and, until thermally stabilized, in other words achieving the same temperature, they perform poorly as an integrated optical system. Providing time for high-magnification refractive lenses to achieve thermal equilibrium is essential when maximum resolution is required.

Thermal equilibrium is less a concern when using short to moderate telephoto lenses (200mm to 400mm), especially when photographing from moderate distances. The reason for this is that lens elements are smaller and distance usually is not challenging the resolution capability of the lens. Neither is light traveling a great distance through the atmosphere on its journey from the subject to the lens.

Thermal equilibrium is important when using telephoto lenses of 600mm or more, especially when photographing from a distance that challenges the resolution of the lens. For example, the Canon and Nikon 600mm f/4 lenses when used with a 2x tele-converter become 1200mm f/8 lenses. As such, each lens is capable of recording recognizable images of people and legible vehicle number plates from a distance approaching 0.8047 kilometer (0.50 mile) under appropriate atmospheric and lighting conditions. Photographing from such great distances requires that the lenses function at maximum efficiency because one is pushing them to their limit of performance. The lens performing at maximum efficiency is less important when photographing a subject from only, for example, 0.40 kilometer (1/4 mile).

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3. Canon and Nikon telephoto lenses consist of numerous lens elements of differing types and sizes of glass. For example, the Canon EF 800mm f/5.6L IS USM super telephoto lens consists of 18 lens elements in 14 groups.

FOUL WEATHER PHOTOGRAPHY

Humidity

Canon recommends not subjecting a digital single-lens reflex camera to relative humidity in excess of 85 percent. That can be a problem in some regions, especially during certain times of the year when relative humidity exceeds 85 percent. Nikon offers no cautionary statement regarding humidity, but Nikon cameras probably suffer the same vulnerability to humidity as Canon cameras do. Indeed, both Canon and Nikon digital single-lens reflex cameras are sophisticated computers with a lens and an image capture device. Humidity also affects modern camcorders.

Hot Weather Photography

During hot weather, stay hydrated and properly fed. Drink correct fluids such as juice and/or water and eat frequent small snacks.

During hot weather, the most important concern is keeping one's body and photographic equipment cool. Certainly, shade is important to prevent direct sunlight on one's self and the equipment. The extent to which high ambient temperatures are a concern varies by region and season.

Hot weather requires wearing appropriate clothing. Light-colored, loose-fitting, lightweight, breathable synthetic fabrics are preferred. Unfortunately, camouflage requirements often prohibit wearing light-colored clothing. While cotton clothing is good during the day, it retains moisture. If cotton garments are the choice, have a dry set to wear after sunset.

During the day, a wide brim hat protects the head and back of the neck. Although not particularly wide brimmed, consider a Boonie hat. Additionally, consider using a neck cooler to stay cool. Neck coolers containing special water crystals are available under a variety of brand names. Most people wear them around their neck to stay cool after wetting them according to the accompanying instructions.

Protect exposed skin from sun damage by using sunscreen, also called sun block. Use a product featuring a Sun Protection Factor (SPF) of 15 or higher. Apply sunscreen minutes before going into the sun and reapply thereafter according to the instructions printed on the container.

During hot weather, stay hydrated and properly fed. Drink correct fluids such as juice and/or water and eat frequent small snacks. Remaining hydrated is important, and it is important to replace chemicals lost through perspiration. Consume liquids and foodstuffs with that in mind. Dehydration leaves

a person listless, tired, and with a diminished attention span and reduced ability to concentrate.

When working outdoors during hot weather, preventing heat stroke and heat exhaustion is important. Know the symptoms. Heat exhaustion is most likely to occur while carrying equipment to and from a rural vantage point during hot humid weather. It is less likely to occur when sitting or standing idle in the shade at the vantage point. When manually transporting equipment, travel slow and rest frequently. As stated, remaining hydrated is important!

Wear sunglasses during the day to protect the eyes from harmful ultraviolet (UV) rays. Wearing sunglasses also preserves the eye's ability to become dark-adapted once day gives way to night. Sports-type wraparound sunglasses provide good protection against brightness by blocking light from all angles.

Cold Weather Photography

> In wintertime, you can either heed the astronomer's standard advice–namely, dress for 20°F to 30°F [-6.66°C to -1.11°C] colder than the actual temperature–or you can learn the hard way. (MacRobert, A. M., 2008, n.p., *The Art of Using a Telescope*)

> Cotton clothing, due to its poor insulating and moisture-wicking characteristics, is virtually useless in most mountain climates, the exception being hot, desert, or jungle mountain environments. Cotton clothing should be replaced with synthetic fabric clothing. (FM 3-97, 2002, August 26, n.p., Military Mountaineering)

Cold weather is challenging when the photography team must be outdoors. Of necessity, team members must remain motionless or risk detection, but remaining motionless leaves them vulnerable to the cold. For that reason, dressing to stay warm and dry is essential. When it rains or snows, wear waterproof outerwear with appropriate clothing underneath, clothing appropriate for the temperature.

During cold weather photography, in addition to keeping warm do what is necessary to keep the temperature of photographic equipment above the manufacturer specified minimum operating temperature. This is important because cameras and automatic lenses can become operationally unreliable in cold weather.

Canon digital single-lens reflex (DSLR) cameras feature a manufacturer recommended operating temperature range of 0–40°C (32–104°F). The intended use of the Astrozap Dew Controller System is to keep the temper-

ature of optical systems above the dew point temperature to prevent moisture (dew) accumulation on their surfaces. An unintended but useful application is to keep photographic equipment above the minimum operating temperature during cold weather photography (refer ahead to Figures 7-18 and 7-19). Apply a Flexi-Heat dew shield and Heat Bands to the lens, and apply a Heat Band to the camera. Having done that, wrap them with an insulating cloth of appropriate camouflage color and pattern. Do not overlook the suitability of using air-activated chemical hand warmers to keep equipment and batteries suitably warm.

Cold temperatures significantly reduce battery performance so keeping one or more fully charged spare camera batteries where body heat will keep them warm is important.[4] Air-activated chemical hand warmers are useful to keep batteries warm; place a hand warmer in the pocket with the batteries. Rotate batteries when required, replacing cold batteries with warm batteries. In some instances, insert a warm battery into the camera when it appears subject activity may soon begin. For example, in the early morning when somebody in a residence turns on lights, anticipate that somebody will soon emerge. Similarly, somebody letting the dog out in the morning suggests that daily activity has begun. Think and anticipate.

Portable hunting blinds, when their use is appropriate, provide shelter from wind, rain, snow, and cold, which increases comfort and provides protection for photographic equipment. Leonard Rue Enterprises, Inc. offers the Rue Ultimate Photo Blind that is reminiscent of a portable hunting blind but configured specifically for photography (www.rue.com). Portable shelters made for photographers and videographers are available from companies such as Filmtools (www.filmtools.com).

When circumstances permit, use a propane tent heater for comfort and for the prevention of hypothermia. Heating the blind also keeps photographic equipment warm enough for reliable operation. An alternative to a hunting blind is constructing a lean-to or debris hut shelter. In some instances, one can use a tent heater in such shelters.

Dressing properly for cold weather is important because while at the vantage point, one is inactive, as stated. Remaining motionless requires dressing extra warm. Wear long underwear, insulated socks, insulated boots, insulated gloves, a stocking hat, and a neck scarf. Layering clothing permits adding

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4. Lithium batteries perform better in cold weather than Alkaline batteries do. For example, the ITT PVS-14 monocular night vision device (NVD) operates in warm weather for approximately 60 hours with an AA Alkaline battery and approximately 70 hours with an AA Lithium battery. That time difference is not significant. In exceptionally cold weather (-35° C, -31° F), however, this same NVD operates for approximately 4 hours with an AA Alkaline battery but operates for approximately 30 hours with an AA Lithium battery. That time difference is significant.

and removing garments as needed according to temperature changes. In addition to a quality pair of gloves, consider oversized insulated mittens with a small hole to permit using the remote shutter release inside the mitten. Sniper gloves are also useful or selectively cut fingers from a pair of preferred gloves. In some instances, a fingerless cold weather sniper glove with a retractable mitten top serves well; remove the mitten portion to expose the fingers when dexterity is necessary to operate equipment such as a camera.

During cold weather photography, especially for an extended stakeout, consider taking into the field a supply of air-activated chemical hand warmers and foot warmer insoles, this product mentioned earlier. Chemical hand warmers are affordable and easy to use. To activate, shake them after removal from the package and the heating process begins. Chemical warmers begin to generate heat when exposed to air and they provide heat for many hours. Heat Factory hand warmers provide heat for eight to 24 hours depending on the size of the product. Two manufacturers of air-activated hand warmers are Grabber® and Heat Factory. Heat Factory provides a good assortment of products from which to choose. Visit their website: www.heat factory.com.

During cold weather photography, do not touch cold metal with unprotected hands. Avoid skin to metal contact by using insulated tripod leg covers (see Figure 7-11), or wrap cloth or foam tape around the legs. Applying a LensCoat Lens Cover to the lens prevents skin to metal contact. In this respect, LensCoat lens covers are suitable for more than just camouflage. When dexterity is required, wear lightweight formfitting cotton gloves to avoid skin to metal contact. To prevent condensation forming on the Camera viewfinder, it is necessary to hold the breath when looking through the camera.

Food and liquid intake is important, this mentioned earlier. Bring high calorie food products to eat, and bring hot liquid in a quality thermos. An extended surveillance will require making provisions for appropriate food and drink, and may require frequent shift changes. Two or more photography teams working from a nearby staging area may be necessary.[5]

Avoid condensation forming on the equipment when transitioning from the cold outdoors to the warm indoors. When brought indoors, cameras and

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5. During the Winter War, the war between The Soviet Union and Finland during the winter of 1939–1940, the Finnish army used the uncharacteristically cold winter to their advantage. A strategy of the numerically outnumbered Finns was to blow up Soviet field kitchens and warming fires. Meantime, fresh Finnish troops frequently relieved those in the field so they could retreat to warming tents for a hot meal and sleep. Reconnaissance by Finnish ski troops, who knew the country, resulted in Finnish commanders usually knowing where Soviet troops were located. Conversely, the Soviets frequently did not know where Finnish troops were located. The Soviet troops, many sent by Stalin from farther south and therefore unfamiliar with warfare in arctic conditions, were cold and hungry in an unfamiliar country, and many froze to death.

Figure 7-11. LensCoat provides LegCoat tripod leg covers that insulate the hands from the cold of the tripod and provide camouflage value. The leg covers also protect the tripod and reduce sound emission during transport and during setup and takedown. Made of closed cell foam padding and heavy-duty neoprene, the covers are soft to the touch but rugged. The LensCoat product line features an assortment of camouflage patterns (i.e., Digital Camo, Forest Green, Realtree Advantage Max4 HD, Realtree Hardwoods Snow, and black). Visit the manufacturer's website to view current products (www.lenscoat.com). Image courtesy of LensCoat.

lenses must be in their case, or in sealed plastic bags, or in waterproof backpacks or duffle bags. Consider using Ziploc bags for small items. Leave equipment in the sealed containers until warmed to room temperature. The warming process usually requires several hours.

When bringing unprotected cameras and lenses in from the cold and condensation forms on their surface, warm them using an electric space heater or conventional hairdryer. Do not overheat them. In some situations, a 12-volt hairdryer that receives power from a 12-volt automobile battery is useful.

Windy Day Photography

Placing a sand bag or shot bag on the telephoto lens or telescope and suspending a sand bag or shot bag from the tripod center brace greatly stabilizes the apparatus against wind.

Wind causes movement of a tripod-mounted camera and lens assembly and that tends to degrade image quality–it causes blurred images. Fortunately, the surveillance specialist can do a number of things to record quality photographic images in spite of wind. Most important among the strategies is using a heavy-duty tripod or some other robust camera support. The Tree Mount Support which is sturdier than a heavy-duty tripod is highly resistant to wind (refer to Figure 3-19 in Chapter 3). When using a tripod, use sand bags or shot bags for support, and use the long lens camera support (refer to Figure 4-62 in Chapter 4).

A fast lens and elevated ISO permits using a fast shutter speed to freeze wind-induced movement of the camera and lens. Remove the camera neck strap when the camera is tripod-mounted because wind tends to cause it to flap around and create vibrations. Placing a sand bag or shot bag[6] on the telephoto lens or telescope and suspending a second sand bag or shot bag from the tripod center brace stabilizes the apparatus against wind.

When circumstances permit, photograph from a position offering shelter from the wind. In some instances, the surveillance specialist can position vehicles to serve as a windbreak (see Figure 7-12). In other instances, the specialist can work from an automobile, van, or box van (truck) with jacks supporting the frame at four points. Thus supported, the vehicle is resistant to wind induced movement, which is necessary when photographing with high-magnification optics. The jacks take the weight off the vehicle suspension. When using jacks to stabilize a vehicle, flag the ignition in some manner to prevent attempting to drive away forgetting that the jacks are in place.

When photographing during windy conditions and the nature of subject activity permits, wait for breaks in the wind and record images during those times. Wind usually is not constant but periodically subsides, even though for only brief moments. Photographing stationary subject matter usually permits using this method. Conversely, human activity requires recording photographic images when the activity occurs irrespective of wind conditions.

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6. Photographers use shot bags containing lead shot to secure the base of light stands. Shot bags are also useful to stabilize telephoto lenses, telescopes, and tripods against vibrations (refer to Figure 4-62 in Chapter 4). Sand bags perform the same function as shot bags. The advantage of sandbags is they can be transported empty and then filled on site using sand, gravel, or dirt. Shot bags have the advantage of being more compact than sand bags of equal weight. The design of shot bags and sand bags prevents leakage of the contents.

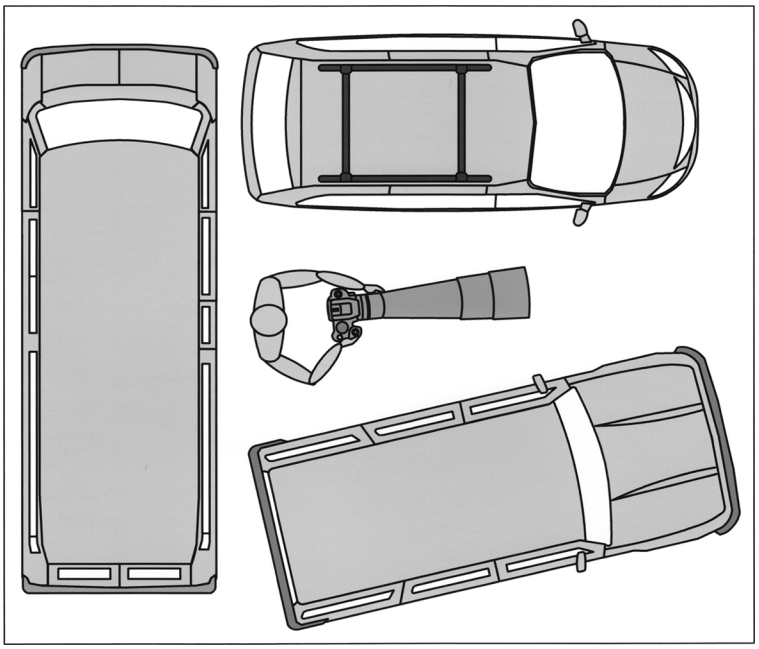

Figure 7-12. In some instances, appropriately positioned vehicles serve as a windbreak. On some occasions, the vehicles also provide visual cover.

Inclement Weather Photography–Rain and Snow

The clandestine photographer should be aware of methods used by wildlife photographers and those in the videography industry, those who use cameras and camcorders outdoors. Make every effort to be aware of what non-clandestine photographers are doing because they are creative and many of their methods are applicable to clandestine photography.

During periods of precipitation, rain or snow, exploit any means to keep photographic equipment dry during use. In some instances, when distance provides cover, a large appropriately colored umbrella or canopy tent is useful, or photograph from a portable hunting blind. In other instances, in rural areas, constructing a field expedient lean-to or debris hut and covering it with a camouflage tarp will keep personnel and equipment dry. In some instances, with luck, a pre-existing shelter of some type exists, whether human-made or natural.

When circumstances permit, consider photographing from within a vehicle. When using high magnification, it is sometimes necessary to place stabilizing jacks under the vehicle at four points to prevent wind caused vehicle

Figure 7-13. The Lightware RC110 Rain Cover fits lenses as large as the Canon and Nikon 600mm f/4 telephoto lenses even when used with a tele-converter as illustrated here. This rain cover also fits the Canon EF 800mm f/5.6L IS USM super telephoto lens, which is about the same physical size as the Canon 600mm f/4 lens. When not taking pictures, position the front of the lens downward to prevent water from running towards the front lens element.

movement. When using a high-magnification optical system from within a vehicle, a custom-made low-profile tripod is sometimes necessary (refer to Figure 3-14 in Chapter 3).

Rain covers made for digital single-lens reflex (DSLR) cameras and camcorders are useful when photographing outdoors during inclement weather, rain or snow, and during dusty conditions. Filmtools sells a variety of rain covers and standby covers for cameras and camcorders. Unfortunately, most commercially available rain covers only accommodate cameras featuring short telephoto lenses. Exceptions include the Laird Rain Hoods market by Leonard Rue Enterprises, Inc., and the Lightware RC110 Rain Cover featured here (see Figure 7-13).

An alternative to purchasing a commercial rain cover is making one using water repellant material or subsequently treating the material of choice with a suitable water repellant product. If lacking the sewing skills and equipment necessary to make a custom rain cover, consult an upholsterer.

In an emergency, when in need of a rain cover but without one, use a garbage bag as a field-expedient rain cover. Cut the end from a black garbage bag and place it over the telephoto lens and camera. Place an elastic band around the front end of the telephoto lens to hold the bag in place. Use a plastic shower cap to protect the camera or camcorder.

Water-Resistant and Waterproof Containers

When transporting or storing photographic equipment under conditions that leave it vulnerable to water damage, place it in water-resistant or waterproof containers. Such containers are available in hard and soft form with the most appropriate choice depending on circumstances. When shock and crush protection is necessary, hard cases are the best choice. The disadvantage of hard cases is their notable bulk and weight. Soft cases lack shock and crush protection, but they weigh less and they are less bulky.

The Class 3 and Class 5 soft containers featured here are good examples of products suitable for the protection of photographic equipment. The three product suppliers are Watershed[7], OverBoard[8], and The Waterproof Store[9] (see Figures 7-14 to 7-17).

The soft water resistant and waterproof containers illustrated here are excellent products. Nevertheless, should one already have, or locate, a soft waterproof container that is suitable for their needs but the color is inappropriate for clandestine use, consider placing it inside a suitably camouflaged nonwaterproof duffel bag or backpack. That method is appropriate even for the products illustrated here. For example, during winter months with snow covering the ground, the bags should be white. In view of that, place them inside a commercially available white duffel bag or backpack, or make white covers.

In response to the absence of a standardized rating system for water resistant and waterproof containers such as duffel bags and backpacks, ROC Gear, Inc.[10] devised a 1–5 rating system. Mr. Jay Buell, CEO, ROC Gear, Inc. generously provided permission to reprint the Waterproof Store Rating System™ for the benefit of readers. This information is important because keeping photographic equipment dry is crucial. The following is "The

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7. Watershed®. 2000 Riverside Drive, Asheville, NC (USA), 28804. Telephone: 800.811.8607. Fax: 828.252.7107. Website: www.drybags.com.
8. OverBoard Accessories Ltd. 16 Eversley Way, Thorpe Industrial Estate, Thorpe, Surrey, TW20 8RG, UK. Telephone: +44 (0)1932 500 091–Ext 3. Fax: +44 (0)1932 505 111. Website: www.overboard.co.uk/catalog/.
9. The Waterproof Store. Website: www.TheWaterproofStore.com.
10. The following four stores are divisions of ROC Gear, Inc.: The Compass Store, Waterproof Store, Altimeter Store, and Solar Power Store. View the stores at: www.rocgear.com.

Figure 7-14. Available in black or smoke green colors, the Class 5 SOF Waterproof Bag System consists of the following products: Small and Medium Utility Bag, both rated to over 20.12 meters (66 feet) submersion depth. Large Ruck Liner, submersible but depth rating not specified. Repair and Maintenance Kit. These products feature an oral inflate/purge valve. Image courtesy of Watershed.

Official WSRS Rating System for Clarifying Water-tightness" (ROC Gear, Inc., 2007, n.p.). View the original at http://www.thewaterproofstore.com/wsrs.html.

Waterproof Store Rating System

Everyone seems to have their own definition of what constitutes "waterproof." For that reason, this rating system was created to present you with a simple way to compare the level of water-tightness across products and manufacturers. After all, a raincoat can be waterproof, right? But will it keep you dry if you jump in a lake? Originally developed by ROC Gear, Inc. for use at The Waterproof Store, but quickly becoming the accepted standard for all types of waterproof containers (cases, bags, backpacks, etc.) These ratings in no way constitute a guarantee from ROC Gear, but rather offers the consumer a way to quickly and easily understand the level of water-tightness among various products from various manufacturers, and present them all

Figure 7-15. Available in black or smoke green colors, the Class 5 SOF Waterproof Bag System, SEAL 5-Bag Kit, designed for special operations forces maritime and undersea operations consists of the following products: Large Ruck Liner, submersible but depth rating not specified. Small and Medium Utility Bags, rated to over 20.12 meters (66 feet) submersion depth. Large Waterproof Backpack, rated to 5.49 meters (18 feet) submersion depth. Weapons Bag, M4-M60, rated to beyond 20.12 meters (66 feet) submersion depth. Waterproof Bag Repair and Maintenance Kit. These products feature an oral inflate/purge valve. Image courtesy of Watershed.

together on one common sliding scale . . . class 1 being the least waterproof, and class 5 being the greatest. The official Waterproof Store Rating System classes are defined as follows:

Class 1. Water resistant for light rain or light splash applications. The product could be permeated by water in any of the following situations: prolonged water exposure, heavy top-down watering, forceful water pressure applications, or submersion.

Class 2. Waterproof in top-down watering applications. The product could be permeated by water in any of the following applications: forceful water pressure, water injected from odd angles, or submersion.

Class 3. Waterproof so tight it floats or can handle quick submersions. The product could be permeated by water in any of the following applications: pro-

Figure 7-16. The Waterproof Ninja Duffel Bag features a capacity of 130 litres (4.59 cubic feet) and a Class 3 water-resistance rating. Image courtesy of OverBoard®.

longed submersion, submersions greater than 3 feet [0.91 meter] in depth, high water pressure applications.

Class 4. Waterproof and submersible to at least 3 feet [0.91 meter], but no more than 12 feet [3.66 meters] (maximum depth varies by manufacturer). This is the first class we refer to as truly submersible. Suitable for underwater sports such as swimming and snorkeling, where great depths are not common. The product could be permeated by water in any of the following applications: submersion greater than manufacturers recommended depth rating, constant submersion longer than 24 hours, extremely high water pressure applications where seals could be damaged.

Class 5. Waterproof and submersible to depths greater than 12 feet [3.66 meters] (often as much as 100 feet [30.48 meters] but varies by product and manufacturer). Suitable for any underwater sport of less depth than the manufacturer's maximum depth rating. Common applications include scuba diving, snorkeling, search & rescue, and white water rafting. The product could be permeated by water in any of the following applications: depths greater than the manufacturer's maximum depth rating or any physical force that could jeopardize the watertight seal.

Figure 7-17. These two products feature a capacity of 30 liters (1.06 cubic feet) and a Class 3 water resistance rating. *Upper image:* Waterproof Sportsman's Backpack 1800 SPBP30L. *Lower image:* Waterproof Sportsman's Duffel Bag SPDF30L. Images courtesy of The Waterproof Store.

Disclaimer: ROC Gear, Inc. has created this WSRS rating system to be used by licensed manufacturers and dealers as a way for consumers to quickly understand the claims being made by any manufacturer or dealer, but the rating claims of the manufacturers or dealers are in fact claims from the manufacturer or dealer, and in no way represent any guarantee from ROC Gear, Inc. Direct product questions should be directed to the product manufacturer. Perceived misrepresentations and/or misuse of the WSRS rating system™ should be reported to wsrsabuse@rocgear.com.

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PREVENTING DEW FORMATION ON PHOTOGRAPHIC EQUIPMENT

> The presence of fog over water surfaces indicates that the temperature and dew point are equal. It also indicates that fog may soon form over ground areas. (FM 3-04.301, 2000, September 29, p. 8–22, *Aeromedical Training for Flight Personnel*)

Introduction

The risk of overnight dew formation on photographic equipment exists when the relative humidity level is high and the temperature of the equipment is cooler than the temperature of the air. Dew point is the temperature to which air must cool to be saturated and thus cause dew and fog formation.

Air contains humidity. Humidity, expressed as a percent, is water vapor in the air that varies daily, seasonally, and geographically. Altalab, Inc. (2006, n.p.), in their Glossary of Weather Terms under the heading *Relative Humidity (rh),* defines relative humidity as the "ratio of the amount of water vapor in a particular temperature air to the maximum amount of water vapor that temperature air could hold." When the temperature of the air and the dew point temperature are the same, water condenses, resulting in the formation of dew and, often, fog.

The U.S. Geological Survey (2008, August 13, n.p.), under the heading *The Water Cycle: Condensation,* explains that, "Condensation is the process by which water vapor in the air is changed into liquid water." Dew is water condensed from moisture in the air and appears as liquid water on surfaces that are cooler than the air. Altalab, Inc. (2006, n.p.), in their Glossary of Weather Terms under the heading Dew, explains that, "Dew is water that has condensed on objects near the ground, as a result of those objects, like car windshields, getting cooler than the Dew Point temperature." In the Glossary of Weather Terms under the heading *Dew Point (DP),* Altalab, Inc. (2006, n.p.) further explains that the dew point is "the temperature at which the air you are measuring would be saturated (100% RH), and condensation (dew) would begin appearing on surfaces."

Condensation in the form of dew occurs most frequently at night with the risk of dew determined by relative humidity and temperature. Ameritherm, Inc. (2010, May 12, n.p.), under the heading *Dewpoint Warning,* explains that, "During the warmer months, if you experience elevated relative humidity (RH), the dew point is elevated, too." Readers who are interested in this phenomenon should research the *kinetic-molecular theory of gasses.*

Modern digital still cameras and camcorders are sophisticated computers, and most modern camera lenses contain a computer chip. As such, mod-

ern photographic equipment is vulnerable to excessive humidity just as computers are. Moisture accumulation on photographic equipment presents the risk of temporary equipment malfunction and, worse, permanent damage. Prolonged moisture can damage cameras and lenses whether the equipment is in use or in storage. In the field, photographing cannot occur when the front element of the telephoto lens becomes wet.

Preventing moisture condensation on photographic equipment is not difficult and several methods exist for accomplishing that. Some methods are passive and some are active.

- Passive method. Place a nonheated dew shade on the lens. Other terms for dew shade include, dew cap, lens shade, and lens shield. This method delays condensation of moisture on the front element of the lens, but it does not keep the lens tube dry.
- Passive method. In addition to using a non-heated dew shade, place a plastic garbage bag over the equipment and/or wrap the equipment with a towel.
- Active methods. Keep the temperature of the equipment above the dew point temperature. The surveillance specialist can accomplish this one of three ways:
  - Use the Astrozap® Dew Controller System designed specifically to keep the temperature of optical systems above the dew point temperature. The Astrozap is also useful to keep photographic equipment warm enough for reliable operation during extremely cold outdoor photography.
  - Use air-activated chemical hand warmers to keep the temperature of the apparatus above the dew point temperature.
  - Use a 12-volt hair dryer to keep the temperature of the apparatus above the dew point temperature. This method is least preferred.

Wrap the Equipment

> Wrap the entire camera with a strip of towel, leaving only the vents open so air will circulate. This almost totally eliminated the condensation problem and now I can cool the camera to -25°C [-13°F] with no bad consequences. (Barnes III, 2009, n.p.)

Cover cameras and lenses using a rain cover or wrap them with material from a plastic garbage bag and/or towels to prevent moisture (dew) accumulation on the equipment. The surveillance specialist may also experiment with alternative covers. While wrapping the apparatus is a passive method, consider making it an active method by introducing air-activated chemical

hand warmers. Hand warmers, under an outer covering of cloth, will keep the temperature of the apparatus above the dew point temperature.

Nonheated Dew Shades

Lens shade, dew cap, dew shield, and dew shade are terms for the same product. Astronomers usually use the terms dew shield, dew cap, and lens shade while photographers generally use the terms lens shade and sun shade. Nonheated dew shades delay the formation of moisture on the front lens element by maintaining inactive air in the region of the lens surface. This passive method generally works for several hours but, eventually, dew begins to form on the optical surface. For that reason, extended surveillance operations usually require using an active method to prevent dew formation.

Telephoto lens dew shades (lens shades) are rigid. Some telephoto lenses feature a built-in lens hood that slides forward for use and retracts for storage. Other telephoto lenses feature a separate lens hood that mechanically attaches to the lens for use and then removed for storage. All photographers and surveillance specialists are familiar with lens shades.

Refracting telescopes often feature a permanently attached rigid dew shade, or a shade that slips onto the lens. The Schmidt-Cassegrain telescope (SCT) commonly features a flexible dew shade featuring Velcro on each end. In use, the specialist wraps the flexible dew shade around the telescope with the Velcro then securing it in place. The dew shade should extend beyond the front of the telescope by a distance equal to the diameter of the telescope.

Heated Dew Shields and Heat Bands

Astrozap provides the heated Flexi-Heat dew shield and Heat Bands to keep the temperature of optical systems above the dew point temperature. Both products receive electrical power from the 12-volt DC Dual Channel Controller. Do not underestimate the value of this product, especially during outdoor nighttime operations.

The Astrozap Dual Channel Controller features four outputs–two channels with two outputs each. Four outputs permit preventing dew formation on the telephoto lens or telescope, the camera, and the objective lens and eyepiece of the spotting scope (see Figures 7-18 and 7-19). To view up-to-date information, visit the Astrozap® website: www.astrozap.com.

The Dual Channel Controller provides controlled electrical power to each optical system and thereby controls temperature. Astrozap explains that, "Each channel controls two outputs for a total of four outputs. Each channel is capable of a duty cycle from 5% on time at the low setting to 95% on time at the high setting" (Astrozap, Oakland Group, Inc., 2006, n.p.). A

Figure 7-18. The Astrozap Dew Controller System prevents dew formation on optical surfaces. *Upper image:* The Astrozap Flexi-Heat dew shield keeps the front lens element (corrector plate) of this 2350mm f/10 Celestron C9.25″ Schmidt-Cassegrain telescope (SCT) above the dew point temperature to prevent dew formation. Heat Bands around the objective lens and eyepiece of the Leupold Mark 4 12-40x60 Tactical Spotting Scope prevents dew formation. The 12-volt DC Astrozap Dual Channel Controller suspended from a small inverted ball-head can assume almost any position the surveillance specialist finds convenient. *Lower image:* The Astrozap Heat Band positioned just behind the unheated lens shade prevents dew formation on the front element of the lens. Heat Bands around the objective lens and eyepiece of the Leupold Mark 4 12-40x60 Tactical Spotting Scope prevents dew formation. The spotting scope and the telephoto lens sport an anti-reflection device (ARD).

Figure 7-19. The Astrozap Heat Bands around the objective lens and eyepiece of the Leupold Mark 4 12-40x60 Tactical Spotting Scope prevents dew formation. The mini-geared head permits precise alignment of the spotting scope with the telescope.

12-volt battery pack is required or one can use power from the vehicle battery.

MOLD IN LENS ELEMENTS

Keeping cameras and lenses dry and using them frequently minimizes the likelihood of mold. Sunlight and ultraviolet light tends to kill fungi. When mold develops between lens elements, replacing the lens is sometimes less costly than paying a repair shop to disassemble the lens to remove the mold.

Chapter 8

HUMAN VISION AND VISUAL AIDS

> Generally, most pilots are poorly informed about night vision. Human eyes never function as effectively at night as the eyes of animals with nocturnal habits, but if humans learn how to use their eyes correctly and know their limitations, night vision can be improved significantly. (Federal Aviation Administration, 2005, August 16, p. 10–1, *Airplane Flying Handbook: Night Vision*)

INTRODUCTION

Everybody knows that humans do not see well at night in the absence of artificial illumination. Cyrus M. Smith (2001, September, p. 2) of the Oak Ridge National Laboratory, referencing J. E. Hardy, explains this as follows:

> The effects of decreased illumination on vision can be dramatic. Visual acuity may be reduced to 20/200 or less, color vision is lost, blue-green lights will appear brighter while red lights will appear dimmer, depth perception is degraded, glare is a factor, and a central blind spot is present.

Nighttime vision reduced to 20/200 or less is serious and can leave a person operating in a visual state equivalent to legal blindness. Writing to the title *What Is Low Vision?,* the Michigan College of Optometry, Ferris State University (n.d., n.p.) reports that "Individuals who are categorized as visually impaired have best corrected visual acuity of 20/70 to 20/100. Individuals who are categorized as legally blind have best corrected vision of 20/200 or worse."

The members of a clandestine photography team who understand the dynamics of human vision can maximize nighttime seeing ability and thus

avoid becoming a victim of diminished visibility. Most subjects of surveillance do not understand the workings of the human vision system and that lack of understanding benefits the photo surveillance team.

The human eye features a maximum aperture of approximately f/2.1. The maximum aperture of some owl's eyes is approximately f/1.1. The maximum aperture of some cat eyes f/0.9. Estimates are that cats see six times better at night than humans do. For humans, decreased illumination can result in a visual acuity reduction to 20/200 or less. In the United States, a person with 20/200 vision is "legally blind." The healthy human eye generally features 20/20 vision. Hawk eyes feature five times as many photoreceptors as do human eyes and, thus, hawks enjoy an estimated 20/2 vision. The large number of photoreceptors and other details of the eye results in hawk vision being about eight times more acute than human vision. Hence, hawks discern detail from distances that require humans to use an 8-power binocular. To enhance vision, humankind invented products such as the binocular, spotting scope, telescope, image intensifier night vision device, and infrared thermal imager. This paragraph is a summary of information from diverse sources.

Understanding how human eyes function enables a person to use their eyes to best advantage by doing the things that enhance vision. Similarly, they can avoid the things that are detrimental to quality vision. Understanding vision also enables them to know what helps and hinders the subject visually and exploit that understanding. During the day and at night, the surveillance specialist and observer must have the ability to see while not being seen.

The human eye contains two visual systems, a daytime *Photopic* visual system and a nighttime *Scotopic* visual system. How a person treats their eyes during the day affects their ability to see at night. While humans cannot see in the dark as well as many nocturnal animals, there are practical things a person can do to maximize their nighttime viewing ability.

When reading this section it will become apparent that two things occur when the eyes become dark-adapted. First, the pupils of the eyes dilate and that occurs quickly.[1] Second, and more importantly, the eye's retina undergoes a chemical change and becomes more sensitive to light; this requires more time. When leaving a well-illuminated environment and entering darkness, it takes five to 10 minutes for the cones of the eye to become more sensitive to light. It takes approximately 30 minutes for the rods of the eye to become fully light sensitive. These two circumstances, discussed in detail

1. Pupils get smaller in bright light to prevent light damage to the inside of the eye. They get larger in dim light to let in more light (Maton et al., 1997, p. 147).

shortly, take place simultaneously.

This discussion examines the function of the human eye and concludes with a brief examination of why nocturnal animals see better in the dark than humans do. While understanding the latter is not essential, understanding the visual system of nocturnal animals adds nicely to one's inventory of knowledge regarding vision. Discussion then proceeds to optical systems to enhance vision. Chapter 5, *Night Vision Photography for Clandestine Operations,* discussed electro-optical systems, specifically image intensifier night vision devices (NVDs) and infrared thermal imagers.

FUNCTION OF THE HUMAN EYE

The human eye contains two separate visual systems. In the presence of sufficient illumination, the cones provide high-resolution color images. Under low-light conditions, the rods provide vision lacking detail and color.

The human eye is marvelous with the operating principal of the eye frequently compared with the camera; some people compare the human eye with a camcorder. Comparing the human eye with the camera is convenient and in some respects useful although not completely reasonable. Nevertheless, comparing the eye and camera provides interesting insight into the miraculous nature of the eye.

The human eye features a converging lens to focus an image upon the retina, and the eye's iris provides a variable diameter opening/aperture (pupil) to regulate the quantity of light entering the eye. A camera features a converging lens with a variable diameter aperture and an image sensor in place of the eye's retina. As for the human eye's light sensitivity, two visual systems exist, as stated. The eye features a *Photopic* daytime system and the *Scotopic* nighttime system. Varied literature suggests that when fully dark-adapted and in the Scotopic rod-based mode, the human eye is approximately equivalent to ISO 800.

As for the eye's resolution capability in comparison to modern digital cameras, estimations in the literature vary from a low of 130 megapixels to a high of 576 megapixels, 576 megapixels appearing most frequently in the literature. A reliable resolution comparison between the human eye and a digital camera is not possible and probably never will be. The resolution of the eye is not uniform across the full field-of-view and the resolution provided by the cones and rods of the eye differ one from the other.

The focal length of the human eye varies from one person to another and ranges from about 13 millimeters to 17.2 millimeters. The aperture range of the human eye as reported in an article titled *F-number,* also varies by indi-

vidual with aperture typically ranging between approximately f/8.3 and f/2.1 (Wikipedia, 2010, June 12, n.p.). By comparison, the eyes of a cat feature a maximum aperture of approximately f/0.9 and the eyes of some owls feature a maximum aperture of f/1.1 (Motani, 2000, November 15, n.p.).

The retina of the eye contains numerous light sensitive cells (photoreceptors) called *rods* and *cones,* approximately 125 million rods and 7 million cones (Towle, 1999, p. 1020). In operation, "Both rods and cones produce nerve impulses that travel from the retina along the optic nerve to the visual center of the brain" (Maton et al., 1997, p. 147).

The cones are concentrated largely in the area of the fovea, which lies within the optical axis of the eye. The cones are responsible for normal daytime (Photopic) vision but do not function well in dim light and do not perform at all in darkness. The rods, located in the area around the fovea, are responsible for nighttime (Scotopic) vision but do not function in bright light such as during daylight hours.

A Dictionary.com (2010, n.p.) article titled *Purkinje Effect* explains that:

> Under most circumstances, either the Photopic system or Scotopic system is active, not both. Under low light levels, the cones are insensitive and do not function. Under high light levels, the rods are saturated, and do not function. Under conditions where it is desirable to have both systems active, red lights provide a solution.

Because of the differing light sensitivity of the cones and rods, the eye contains two separate visual systems, as stated. The eye contains a daytime *Photopic* visual system and a nighttime *Scotopic* visual system. Maton et al. (1997, p. 147) explain this as follows:

> The retina is the eye's inner layer of tissue. It contains more than 130 million light-sensitive receptors called rods and cones. Rods react to dim light but not to colors. Cones are responsible for color vision, but they stop working in dim light. This is why colors seem to disappear at night, when you are seeing with only your rods.

The cones, which lie primarily within the optical axis of the eye, are not highly sensitive to light and therefore require sufficient illumination to function. The cone section of the eye features approximately 7 million densely supplied cells, the cones producing a high-resolution color image when sufficient illumination exists.

The rod section of the eye features approximately 125 million cells surrounding the area of the fovea. The rods are highly sensitive to light and provide night vision. Limited cell density, however, results in the rods produc-

ing an image lacking in detail, and rods provide no color.

In an article titled *The Incredible Machine,* The National Geographic Book Service (1994, p. 279) explains that, "Long rods translate dim light into shades of gray so we can see shape and movement but not color; shorter cones absorb spectral light, enabling us to see myriad hues." Clearly, although humans possess color vision, humans do not always perceive color. Humans perceive color only when lighting is adequate.

In Color Matters, under the title *How Animals See Color,* J. L. Morton (2008, n.p.) explains that, "Humans are color-blind in dim light (such as night time with very little moonlight)." Under the title Color *Vision for Mice,* J. L. Morton (2008, n.p.) explains that, "Nocturnal animals–such as foxes, owls, skunks, and raccoons–whose vision is specialized for dim light seldom have good color vision. By comparison, humans are color-blind in dim light."

Information up to this point leaves it clear that the human eye contains two separate visual systems. In the presence of sufficient illumination, the cones provide high-resolution color images. Under low-light conditions, the rods provide vision lacking detail and color. At certain illumination levels, neither visual system works well, this phenomenon discussed shortly under the heading *Mesopic Vision.*

When a person enters a dark environment, production of a rose-red pigment of the retina called Rhodopsin (visual purple) causes the rods to become highly sensitive to light. In an article titled *Anti-Human Rhodopsin Purified,* Leinco Technologies, Inc. (2009, n.p.) explains that, "Rhodopsin is extremely sensitive to light, and enables night-vision. Exposed to white light, the pigment immediately photo bleaches, and it takes about 30 minutes to regenerate fully in humans." Once Rhodopsin in the rods photo bleaches, the eyes lose their dark adaptation–human eyes acquire dark adaptation slowly but lose their dark-adapted state quickly when exposed to bright light. An article titled *Night Vision* (Wikia, Inc., 2010, n.p.) confirms this explaining that, "In biological night vision, molecules of rhodopsin in the rods of the eye undergo a change in shape as light is absorbed by them. The peak rhodopsin build-up time for optimal night vision in humans is 30 minutes."

When transitioning from a brightly illuminated environment to a dimly illuminated environment, a time exists wherein a person cannot see well, if at all. The extent of this phenomenon depends on the degree of difference between the two levels of illumination, and it varies somewhat between individual people. Some people dark-adapt quicker and more thoroughly than others do. Chapter 10 of the United States Federal Aviation Administration *Airplane Flying Handbook* (2005, August 16, pp. 10–1 to 10–2), under the heading *Night Vision,* explains the dark adaptation process as follows:

The eye's adaptation to darkness is another important aspect of night vision. When a dark room is entered, it is difficult to see anything until the eyes become adjusted to the darkness. Most everyone has experienced this after entering a darkened movie theater. In this process, the pupils of the eyes first enlarge to receive as much of the available light as possible. After approximately 5 to 10 minutes, the cones become adjusted to the dim light and the eyes become 100 times more sensitive to the light than they were before the dark room was entered. Much more time, about 30 minutes, is needed for the rods to become adjusted to darkness, but when they do adjust, they are about 100,000 times more sensitive to light than they were in the lighted area. After the adaptation process is complete, much more can be seen, especially if the eyes are used correctly.

The human eye featuring two visual systems results in a tremendous range of light sensitivity. The eye's remarkable range of light sensitivity is the consequence of the two types of photoreceptors, cones and rods, and only marginally because of the range of the pupil diameter. The increase in the eye's pupil diameter is relatively insignificant inasmuch as it contributes little to dark adaptation in comparison to what the chemical changes contribute. John Dowling explains that, "in the human eye the diameter of the pupil varies between 2 and 8 mm, a range allowing for only a 16-fold change in area. This mechanism can account for adaptation over a range of only about 1 log unit. Thus, the greater part of adaptation must be attributable to mechanisms occurring within the retina or elsewhere in the visual pathway" (Dowling, J. E., 1987, p. 187).

It is important to understand that the production of Rhodopsin (visual purple) occurs only if the body contains a sufficient quantity of vitamin A. Because the human body does not produce vitamin A, diet must provide the proper amount of this vitamin or night blindness (nyctalopia) can result. Ensure a proper diet because as MedicineNet, Inc. (2010, n.p.) explains in an article titled *Definition of Nyctalopia,* "Rhodopsin, maintains its photosensitivity only in the presence of vitamin A."

MESOPIC VISION

Diminished Visibility at Dusk and Dawn

During the period of Mesopic vision, the subject cannot see well and that circumstance is exploitable. Realize, however, that one's own vision suffers impairment during that time.

Every morning and evening, during dawn and dusk, there is a transitional period between Photopic and Scotopic vision when neither visual system performs efficiently. That is the period of Mesopic vision. It is too dark for the cone-based system and too light for the rod-based system. During clandestine operations, be vigilant during those times of visual impairment.

The period of Mesopic vision, the time of diminished visibility, varies in duration by geographic region, time of year, and variable atmospheric conditions. Dr. Irv Bromberg (2007, September 16, n.p.), University of Toronto, Canada, explains this as follows:

> Twilight is that period of dusk after sunset or dawn before sunrise during which the sky is partially lit by atmospheric scattering of sunlight. The duration of twilight after sunset or before sunrise depends on atmospheric conditions (clouds, dust, air pressure, temperature, humidity) and on the parallactic angle (the angle between the path of the setting or rising sun and the local horizon), both of which vary with the seasons (specifically the solar declination) and the terrestrial latitude.

PURKINJE EFFECT

> Purkyně discovered that "as light intensity decreases red objects seem to fade faster than blue objects of the same brightness" (Kriff, n.d., n.p., *Jan Evangelista Purkyně*).

Discussion of Mesopic vision demands discussion of the Purkinje effect. The terms *Purkinje effect*[2], *Purkinje shift*, and *Purkinje Phenomenon* are synonymous and refer to the visual shift that occurs as the intensity of illumination decreases. The human eye, previously stated, features two visual systems, a daytime (*photopic*) system and a nighttime (*scotopic*) system. The cones, responsible for daytime vision, respond best to yellow light. The rods, responsible for nighttime vision, respond best to blue-green light.

As illumination decreases, a transition occurs because the cones cease to function and the rods begin to function. As explained by Wikipedia® (2010, June 8, n.p.) under the title *Purkinje effect,* "The Purkinje effect occurs at the transition between primary use of the Photopic (cone-based) and Scotopic (rod-based) systems: as intensity dims, the rods take over, and before color

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2. Jan Evangelista Purkyně (1787–1869), also identified as *Johannes Evangelists Purkinje,* was a physiologist and resident of what is now the Czech Republic. Purkyně discovered the phenomenon that scientists named in his honor, the *Purkinje effect, Purkinje shift,* and *Purkinje Phenomenon.* Purkyně discovered that "as light intensity decreases red objects seem to fade faster than blue objects of the same brightness" (Kriff, n.d., n.p., *Jan Evangelista Purkyně*).

disappears completely, it shifts towards the rods' top sensitivity." During the transition period of the Purkinje shift, people do not see well, this discussed previously under the heading *Mesopic Vision.*

Before proceeding, contemplate the insights of Daniel Berger and Marian Morys whose article appears here with the generous permission of Saul Berger, President, Solar Light Company, Glenside, Pennsylvania (USA). They wrote:

> The spectral response of the human eye changes with light intensity. The eye has two distinctive spectral responses, which are defined according to the brightness of the light entering the eye. The first spectral response of the eye occurs under typical daytime lighting conditions (Photopic) defined for light intensity greater than 0.1 Lux. The second spectral response occurs under low light conditions (Scotopic) defined for light intensity between 0.01 and 0.0001 Lux. Light intensity less than 0.0001 Lux is undetectable by the human eye. The eye's shift from the Photopic response to the Scotopic response is known as the Purkinje shift.
>
> Thayer blue paint, formula designation 5-B, Navy Department Specification 52P47, was a light blue paint used by the United States Navy during World War II for the camouflage painting of warships. (Snyder & Short Enterprises, n.d., n.p., *Table of Paints Used by the USN during WWII*)

The following is an interesting piece of military history regarding application of the Purkinje effect. During World War II, the United States Navy incorporated the dynamics of the Purkinje effect into paint color choices for the camouflage painting of some warships. The intended purpose of the Thayer System (Thayer blue paint) was to make ships appear different under low light versus normal daytime illumination. The intention also was to frustrate enemy estimation of target angle and thus direction and speed of travel, to thwart torpedo accuracy. The Historic Naval Ships Association copied the manual, *Ship Camouflage Instructions,* Ships 2, 1942, and made it available at their website. An excerpt from the manual reads as follows:

> The special feature of this system is its changeable character. At low levels of illumination a blue paint will appear relatively lighter and a red paint will appear relatively darker than these two paints appear in daylight. This visual change, known as the Purkinje effect, is utilized in the Thayer System. The pure light blue which is employed has been selected because it will appear practically like white paint at low levels of illumination. The ship will therefore appear like a white ship on moonless nights or during twilight when white or very light ships are best for reduced visibility. During daylight hours or under bright moonlight the pattern will be apparent and will

> produce some deception in the estimation of the target angle. A darker blue would produce more deception but cannot be used because it will not appear white at night. The purity of the color is an important factor in the Purkinje effect, and even a slight admixture of black in the paint will reduce its effectiveness at night. (The Historic Naval Ships Association, 2009, p. 14)

ACQUIRING AND MAINTAINING DARK ADAPTATION

> Low-intensity red light does not neutralize the dark-adapted state of the eyes because Rhodopsin in the rods is insensitive to the longer red wavelength of light.

Approximately 30 minutes is required for the human eye to become fully dark-adapted. For that reason, before embarking on a rural nighttime mission, one should provide the eyes the required 30 minutes (or more) to become fully dark-adapted. Unfortunately, while 30 minutes is required for the eyes to become fully dark-adapted, only a brief exposure to bright light neutralizes the dark-adapted state. When that occurs, 30 minutes is required to reestablish dark adaptation.

Once the eyes become dark-adapted, do what is necessary to prevent losing the dark-adapted state. For example, if a bright light briefly shines in one's direction, such as automobile headlamps, close the eyes so they remain dark-adapted. If maintaining visual observation during that time is necessary, close one eye so it remains dark-adapted even though the open eye will cease to be dark-adapted. The eyes dark-adapt independently of each other.

When using a flashlight (torch) is necessary, use a flashlight featuring a red lens or low-intensity red LED (light emitting diode). Low-intensity red light does not neutralize the dark-adapted state of the eyes because Rhodopsin in the rods is insensitive to the longer red wavelength of light. Because Rhodopsin in the rods is not sensitive to red light, it undergoes no chemical change.

During the dark-adapted state wherein the rods provide vision, it is interesting to note that a person sees by means of the cones when using a low-intensity red light. An article titled *Night Vision* (Wikia, Inc., 2010, n.p.) explains that, "Rhodopsin in the human rods is insensitive to the longer red wavelengths of light, so many people use red light to preserve night vision as it will not deplete the eye's rhodopsin stores in the rods and instead is viewed by the cones."

The ability to remain dark-adapted is why, when using an image intensifier night vision device (NVD), an NVD monocular for one eye viewing is sometimes preferred over an NVD biocular or binocular that provides two-

eye viewing. The brightness of the NVDs green phosphor screen image is sufficient to neutralize the dark-adapted state of the eyes. Using an NVD monocular leaves the observer with one dark-adapted eye. Using a biocular or binocular NVD leaves both eyes without dark adaptation. When using an NVD monocular for direct viewing, consider using the nondominant eye so that the dominant eye remains dark-adapted.

THE SUBJECT OF SURVEILLANCE SHARES DARK-ADAPTATION DIFFICULTIES

Understanding how the two visual systems of the eye function provides an advantage over a subject who does not share that understanding.

It is important to understand that while achieving dark adaptation takes a full half hour, sometimes longer, only brief exposure to bright light neutralizes dark adaptation; the subject suffers the same disadvantage. Understanding how the two visual systems of the eye function provides an advantage over a subject who does not share that understanding.

Being aware of the principals of vision enables one to understand why, if a subject transitions from a well-illuminated environment to an area featuring low-level artificial illumination, complete dark adaptation will not occur. Moreover, when the subject looks in the direction of the surveillance team, he or she looks from an illuminated environment into the darkness beyond. Detecting even a poorly concealed surveillance team under that circumstance is unlikely unless some other situation betrays the team's presence.[3] Unfortunately, when the photography team is in an area dark enough to achieve and maintain dark adaptation but they are observing an illuminated subject area, their eyes cannot become dark-adapted. This is why use of an eye patch to cover one eye, or use of a red-lens dark adaptation goggle is sometimes necessary.

EFFECTIVE NIGHTTIME VIEWING: AVERTED VISION

The cones of the eye, previously stated, are concentrated in the area of the fovea, which lie in the optical axis of the eye's lens. The rods are located in the area outside of and around the fovea (see Figure 8-1). For that reason,

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3. Remember the principles of camouflage. The things that capture the subject's attention are shape, shine, shadow, silhouette, surface, and movement.

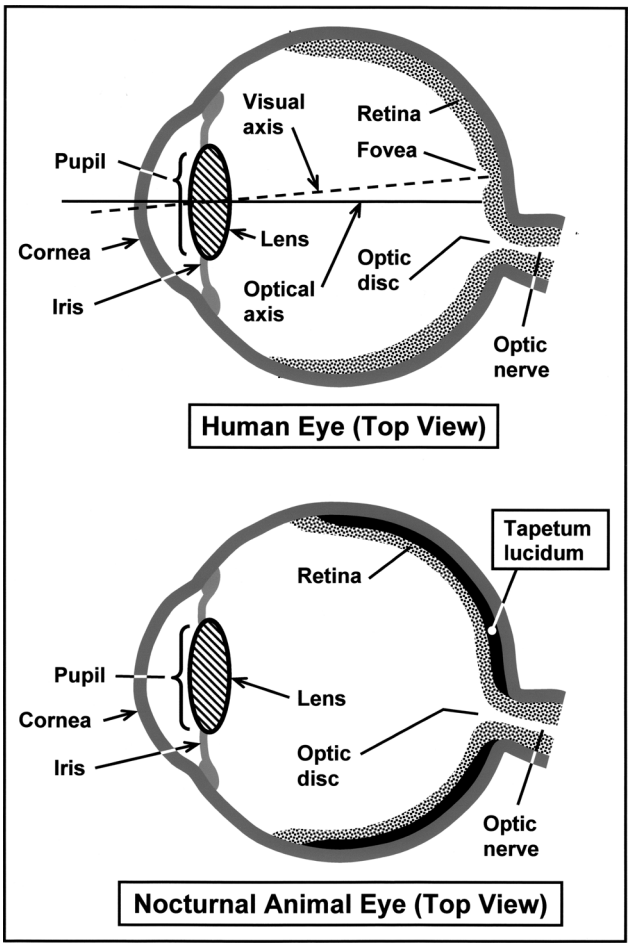

Figure 8-1. *Upper image:* The horizontal section of the right human eye shows the fovea containing cones and the area around the fovea consisting largely of rods. No cones or rods exist in the area of the optic disc, which creates a blind spot. *Lower image:* The horizontal section of the right eye of a nocturnal animal shows that it is similar to a human eye. Unlike the human eye, however, it contains a reflective layer called tapetum lucidum, which enhances the animal's low-light vision. Further discussion appears later under the subheading *Nocturnal Animal Eyes Versus Human Eyes.*

when viewing under low-light conditions, one will see better when using *averted vision,* that is, looking a little above, below, or to the side of an object, viewing 15–20 degrees off center. The reason for this stems from the fact that the eye's lens must project the image onto the very light sensitive rods rather than onto the less light sensitive cones. This is why, for example, when one

is night driving (slowly) without lights, visibility is better when looking a little above the road rather than directly at it.

THE EYE'S BLIND SPOT

Because no light sensitive cells exist in the area where the optic nerves connect to the retina of the eye, human eyes feature a blind spot. However, people are not normally aware of the blind spot because the brain and the overlapping visual coverage of the opposite eye fill it in. Understanding this is important when wearing an eye patch in order to have one dark-adapted eye.

On a white sheet of paper, use a pen or pencil to create two dark circular dots about 0.64 centimeters (1/4 inch) in diameter. Space the dots about 10.16 centimeters (4 inches) apart. Close the left eye and view the dot using the right eye while holding the paper about 25.4–35.56 centimeters (10–14 inches) from the eye. While looking at the left dot using the right eye, alter the distance between the paper and the eye until the dot to the right disappears. When the dot disappears, it does so because the lens of the eye projects the image of the dot onto the area of the optic nerve where no rods or cones exist. When the dot disappears, move the paper closer and then farther from the eye and observe that the dot repeatedly disappears and reappears. Then, hold the paper steady at the point where the second dot is not visible and open the closed eye. The second dot immediately reappears. This latter exercise illustrates that each eye compensates for the blind spot of the other. Repeat the exercise using the opposite eye.

The lesson in the above exercise is clear. As people go about their daily lives, the brain and eyes work together to fill in the blind spot so that no blind spot appears to exist in either eye. When reading the section discussing the use of eye patches to ensure having one dark-adapted eye, reflect on this information. The covered eye cannot compensate for the blind spot of the uncovered eye.

When wearing an eye patch, guard against failure to see something important because of the uncovered eye's blind spot. Accomplish that by not fixating on one limited area but keep the eye moving, in increments, about the area requiring scrutiny.

VISUAL DETECTION OF MOVEMENT

While the human eye is quick to detect movement, even in the range of peripheral vision, the eye is unable to distinguish detail unless the image is

stationary upon the retina. It is for this reason that the eye must follow a moving object or person to discern detail. It is also for this reason that that one should view a large area in segments rather than visually sweeping the area. View a large area in sections and permit the eyes to come to rest on each area, at least briefly, before studying adjacent areas.

The inability of the eye to distinguish detail when the image moves upon the retina is why mounting binoculars to a tripod or some other steady support is beneficial. During stationary surveillance, support even 7x50 binoculars even though most surveillance personnel consider them suitable for handheld use. To confirm this, mount a 7x50 binocular to a tripod and study a distant subject. Then, scrutinize the same area while handholding the binocular. The difference is significant. One can, for example, read vehicle number plates (license plates) from greater distances when using a firmly mounted binocular versus when handholding the same binocular.

Image stabilized binoculars provide a quality movement-free image when handheld, but low-light models remain unavailable. Hence, image-stabilized binoculars are limited to daytime use and for nighttime use in situations where the subject area features adequate artificial illumination, such locations being common in the urban environment.

FIELD OF VISION

While a person's field-of-view is quite wide, detail in the areas surrounding the object focused upon is limited. When looking at a stationary object that is directly ahead of the viewer, a person's field-of-view is 160° to 180° horizontally and 140° vertically. Each eye has a horizontal field-of-view of about 150° with the field of each eye overlapping with that of the other. The brows and cheeks limit the range of vertical field-of-view; articulating the eyes upward and downward in no way alters the vertical field-of-view. Altering the vertical field-of-view requires articulating the head. The nose limits the horizontal field-of-view of each eye (see Figure 8-2).

While a person's field-of-view is quite wide, detail in the areas surrounding the object focused upon is limited. However, the eye is quick to detect motion in the outer areas, especially if an immobile background accentuates the motion.

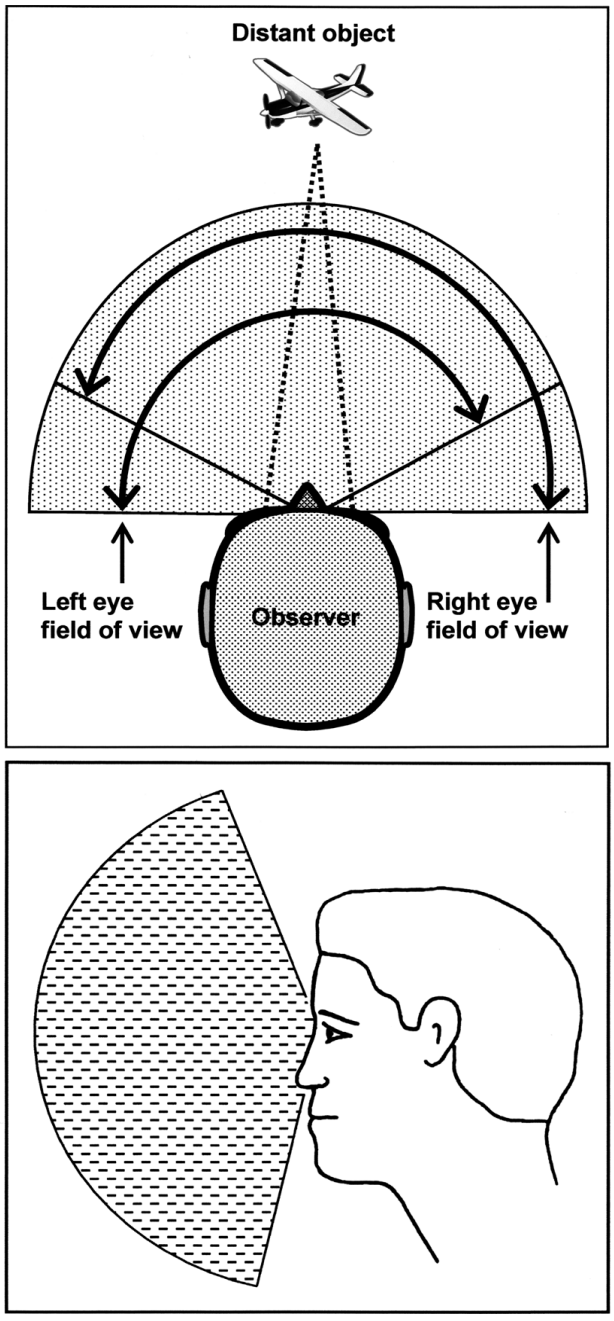

Figure 8-2. Each eye has a horizontal field-of-view of about 150° with both eyes together offering a total field of 160° to 180°. Observe that the field of each eye overlaps with that of the other. The vertical range of the eyes is about 140° and bounded above by the brows and below by the cheekbones.

EYE PATCHES, RED-LENS DARK ADAPTATION GOGGLES, AND SUNGLASSES ENHANCE DARK ADAPTATION

Eye patches make having one dark-adapted eye possible because each eye dark-adapts separately. One eye can be dark-adapted while the other is not.

Introduction

Some nighttime operations require the eyes to be dark-adapted while other operations do not. Some operations require the ability to observe under low light, such as when the subject area is unlit. In other instances, the level of artificial illumination in the area of the subject makes dark adaptation impossible but unnecessary even though working from a dark vantage point. Yet, even though a subject area may be illuminated, having one dark-adapted eye may be necessary should escape or evasion through a dark area become necessary.

When photographing from a dark area but the subject area features illumination, the eyes cannot become dark-adapted. When an illuminated subject area makes dark adaptation impossible but safety and security require having a dark-adapted eye should escape, evasion, or defense become necessary, wear an eye patch over one eye. Wearing an eye patch permits the covered eye to be dark-adapted. Both eyes become dark-adapted when wearing a red-lens dark adaptation goggle, even though observing an illuminated subject area.

This section discusses methods for achieving and maintaining dark adaptation. The next section, *Measures to Maximize Nighttime Vision,* discusses what a person can do to ensure his or her eyes are capable of dark adaptation to the maximum extent possible.

Sunglasses

Wear suitable sunglasses on bright days to protect the eyes from harmful ultraviolet (UV) rays and to prevent the rods of the retina becoming overstimulated and less sensitive to light. Sports-type wraparound sunglasses provide good protection against brightness by blocking light from all angles. Failure to wear sunglasses can result in diminished night vision and an increased time for the eyes to become fully dark-adapted, if they can attain full dark adaptation because of overstimulation. Kevin Fly Hill (2005, October 24, n.p.), in a discourse titled *Introduction to Dark Adaptation,* explains the importance of wearing quality sunglasses:

> . . . under bright light exposure, pigment epithelium cells which lay next to the rods tend to "grow around" the rods. This may be a mechanism that protects the receptors, since the "job" of these cells is to dampen out any reflected light within the eye. This slow process may be one factor in delayed dark-adaptation response following extended bright light exposure.

Red-Lens Dark Adaptation Goggles

> Red-lens dark adaptation goggles block visible light below 600 nanometers (nm) and that permits the eyes to become dark-adapted while performing other tasks in an illuminated environment.

Red-lens dark adaptation goggles are useful for anybody who must leave a normally illuminated environment and enter a dark environment with their eyes already dark-adapted. Dark adaptation goggles are useful for some military operations and clandestine photographers find them useful. Interestingly, though, dark adaptation goggles originated in the medical field in 1916 and remained in use until the 1950s when advanced medical equipment rendered them obsolete.

Sciencestage.com (n.d.) explains that, "Red adaptation goggles were first invented by Wilhelm Trendelenburg in 1916 for early radiologists to use to adapt their eyes to view the light produced by fluorescent screens during fluoroscopic procedures." Advanced medical equipment eventually eliminated the need for radiologists to use dark adaptation goggles. A Wikipedia article explains that, "The development of the image intensifier and the television camera in the 1950s revolutionized fluoroscopy. The red adaptation goggles became obsolete as image intensifiers allowed the light produced by the fluorescent screen to be amplified, allowing it to be seen even in a lighted room" (Wikimedia Foundation, Inc., 2011, February 23, n.p., *Fluoroscopy*).

Although the medical field lost need for red-lens dark adaptation goggles, military forces did not. Military forces in the United States and other countries used red-lens dark adaptation goggles during the Second World War, and they still use them today. Excerpts from modern training manuals of the United States Army and Navy attest to the importance of being able to leave an illuminated environment and enter a dark setting with eyes that are already dark-adapted. The excerpts read as follows:

> *United States Army.* "Aircrew members, if possible, should wear approved red-lens goggles or view under red lighting before executing night-flying operations to achieve complete dark adaptation. This procedure allows aircrew members to begin dark adaptation in an artificially illuminated room before flight. Red lighting and red-lens goggles do not significantly interfere

> with the production of rhodopsin to stimulate the effectiveness of the rods for night vision. Red lighting and red-lens goggles decrease the possibility of undesirable effects from accidental exposure to bright lights; this is especially true when aviators are going from the briefing room to the flight line." (FM 3-04.301, 2000, September 29, p. 8-12, *Aeromedical Training for Flight Personnel*)

> *United States Navy.* "Dark adaptation before going on watch consists of spending at least 30 minutes in darkness or with the eyes protected by red goggles. Wearing red goggles is effective because red light does not affect the eyes. To complete adaptation for a night watch, spend 5 minutes on deck before relieving the watch. These 5 minutes allow the eyes to adjust to the amount of illumination in which they will work." (NAVEDTRA 12968-D, 2007, February, p. 16, *Lookout Training Handbook*)

The electromagnetic spectrum is vast, ranging from long wavelength low-energy radio waves on one end to short wavelength high-energy gamma rays on the opposite end. About midrange between the two is the "visible light" portion of the spectrum. In the literature the numbers vary somewhat but, generally, it is accepted that humans see within a frequency range of about 400–700 nanometers (nm). Kenneth Koehler (1996, n.p.) explains that, "We call the 400 to 700 nm range of wavelengths 'visible' because those are the wavelengths to which our eyes are sensitive."

Red-lens dark adaptation goggles block visible light below 600 nanometers (nm) and that permits the eyes to become dark-adapted while performing other tasks in an illuminated environment. Hence, the goggles enable a person to become dark-adapted prior to entering a dark environment (see Figure 8-3). For many nighttime operations that is necessary. Moreover, wearing dark adaptation goggles when temporarily exposed to white light will preserve the dark-adapted state of the eyes. Temporary lights include but are not limited to the lights of an approaching automobile, a subject turning on a yard light, or when using a flashlight without a red lens. *Note:* Outside at night, one does not see well while wearing a red-lens dark adaptation goggle. If wearing them while walking or driving, do so with caution.

At the time of this writing, the civilian marketplace offers no red-lens dark adaptation goggles. Fortunately, making them is easy because all one must do is replace the clear or tinted lens of a goggle with dark red Plexiglas that blocks light below 600 nanometers. The styling of some goggles permit lens replacement and some do not.

Ridout Plastics Co. Inc. (www.eplastics.com) sells various size sheets of "colored transparent" Plexiglas. Their Dark Red Plexiglas 2423 Acrylic Sheet begins transmitting light at approximately 600 nanometers, the same

Figure 8-3. Wearing a red-lens dark adaptation goggle 30-45 minutes before venturing into the dark of night permits the eyes to become dark-adapted while performing other tasks in an illuminated environment. Some nighttime operations require that the surveillance team be dark adapted when entering darkness. *Upper left image:* Military sun, wind, and dust goggle. Lenses are interchangeable. The manufacturer provides this goggle with a clear lens and a tinted lens. Use one of the lenses as a template when making a red lens. After cutting a red lens to size, apply heat to bend it to the desired radius. *Upper right image:* Soft frame welding goggle fitted with a custom-cut rectangular red lens. Some welding goggles feature a flip-up lens frame, which is a useful feature in some instances. Mount the red lens to the portion that flips up. This goggle leaves one feeling as if they have tunnel vision. *Lower image:* Soft frame welding goggle fitted with two custom-cut round red lenses. This goggle is more comfortable to wear and it provides a better field-of-view than the upper right welding goggle does. Neither welding goggle provides the comfort and field-of-view that the military goggle in the upper left image does, but they are quick and easy to fit with red lenses.

point that red-lens dark adaptation goggles begin transmitting light. The smallest size sheet that Ridout Plastics sells is 0.6096 x 1.2192 meters (2 x 4 feet). Thickness choices include 3.175 millimeters (0.125 inch) and 1.524 millimeters (0.060 inch). The sheets are shipped paper masked for protection.

Replacing the flat lens of a soft frame welding goggle using this plastic is a quick and easy way to create a functional dark adaptation goggle. Use 3.175 millimeters (0.125 inch) thick plastic for this purpose. Making a lens for a conventional military goggle featuring interchangeable lenses is a bit more involved but not difficult. Use the goggle lens as a template to create a cut line, cutout the new lens, and then apply heat to bend it to the desired radius. Use 1.524 millimeters (0.060 inch) thick plastic for this purpose.

CASE EXAMPLE OF DARK ADAPTATION GOGGLE USE. The nighttime stakeout occurred in a darkened semirural area. In front of the vantage point

was the artificially illuminated subject area. Behind the vantage point was a cornfield. At the vantage point, dark adaptation was unnecessary and in fact impossible because the subject area was illuminated. However, foot travel to and from the vantage point through the cornfield was easier and safer when dark-adapted. The procedure was for a vehicle to transport personnel to the far side of the cornfield, far removed from the subject's view, and from there they walked through the cornfield to the vantage point. To be dark-adapted for the hike through the cornfield, specialists donned a red-lens dark adaptation goggle 30 minutes before their scheduled drop-off time at the cornfield; they arrived at the cornfield dark-adapted. Once exiting the vehicle, they waited for it to leave and then they removed their goggles and began the foot trek through the cornfield, being fully dark-adapted for the journey. The specialist on site, once relieved, donned dark adaptation goggles and waited 30 minutes to become fully dark-adapted. After 30 minutes elapsed, they removed the goggles and began their dark-adapted foot trek through the cornfield where a vehicle retrieved them.

Eye Patches

> Relative to Magic Thimble eye patches, the flat black and olive drab green colors register the same when viewed with an image intensifier night vision device (NVD) with and without supplemental infrared (IR) illumination. One color is no better than the other is insofar as NVD detection is concerned.

When circumstances require ensuring that one eye achieves and maintains dark adaptation, eye patches work well. Eye patches make having one dark-adapted eye possible because each eye dark-adapts separately. One eye can be dark-adapted while the other is not.

Some people prefer concave patches while others prefer flat patches. One user of eye patches said she prefers flat patches because they force her eye to remain closed. Keeping the eye closed is good because the light seal between the face and eye patch is not perfect.

When wearing an eye patch, remain alert because horizontal field-of-view is restricted on the patch side of the head. To compensate for the restricted field-of-view, frequently rotate the head or upper body as necessary to view the surroundings.

An eye patch not only limits horizontal field-of-view, the covered eye cannot compensate for the blind spot of the uncovered eye. Although the covered eye cannot provide a view that compensates for the vision lost to the blind spot of the uncovered eye, the brain fills in the blind spot so the viewer is not aware of it. If the observer visually fixates on a limited area, failing

to survey the broader area, somebody can approach and go unnoticed if the lens of the eye projects their image onto the blind spot. Refer to the earlier subheading *The Eye's Blind Spot.*

When wearing an eye patch, one no longer has stereoscopic vision so depth perception is impaired. Approximately 63.5 millimeters (2 1/2 inches) separate the center of the pupil of each eye. The separation of the two eyes provides a stereoscopic view and, thus, depth perception. The view provided by each eye is slightly different from the other, but the brain fuses them resulting in the viewers ability to perceive distance. Fortunately, the loss of depth perception is primarily for close range viewing. Beyond approximately 6.10 meters (20 feet), the loss of depth perception is less noticeable.

Some people who lost vision in one eye report considerable difficulty adapting to the loss of depth perception while other people report little difficulty. To compensate for the loss of depth perception, many monocular vision people rock their head back and forth to acquire different perspectives. The LostEye article *Depth Perception . . . Is Grossly Overrated!* advises to "move your head slightly from side to side so that you get a couple of different images from your one eye for your mind to compare. This allows you to, essentially, with one eye mimick what you would see with two eyes, and thus alleviate the close-in depth perception problem" (Adkisson Publishing Inc., 2010, n.p.). When wearing an eye patch, use this method to acquire some degree of depth perception.

When considering an eye patch, realize that some patches are left or right eye specific relative to shape and offset strap locations. Moreover, size and style options exist. Although creativity enables one to fashion an eye patch, one may purchase reasonably priced eye patches from a medical supply company, or commercial manufacturer. The authors prefer commercial eye patches because they are more comfortable to wear. The Magic Thimble[4] manufactured the eye patch illustrated here (see Figure 8-4).

Whether to wear a flat or concave-shaped eye patch is a matter of personal preference. Some users purchase flat patches to wear under an eyeglass lens, while others prefer a flat patch because it forces them to keep the eye closed. A closed eye compensates for the imperfect light seal between the patch and face. Some users find concave patches more comfortable. Eye

4. The Magic Thimble. Address: PO Box 263, Mattawan, MI 49071. Homepage: www.magicthimble.com E-mail: Nancy@magicthimble.com The Magic Thimble manufactures concave and flat eye patches using soft material. Concave patches permit keeping the covered eye open while flat patches require keeping the covered eye closed. One may wear flat patches under eyeglasses. The Magic Thimble offers an impressive assortment of eye patch designs and accepts custom design orders. One may hand wash and line dry Magic Thimble eye patches.

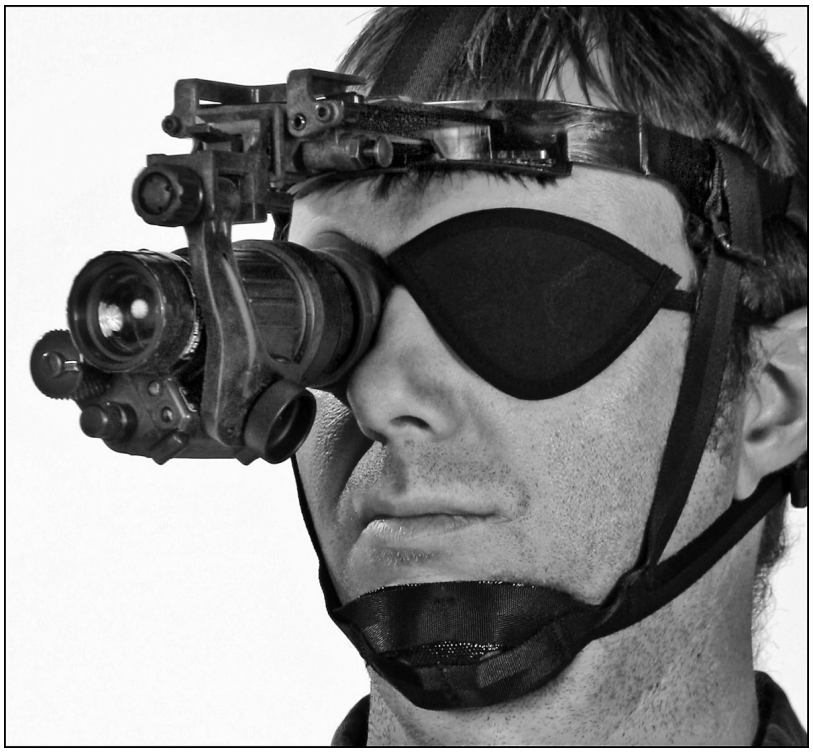

Figure 8-4. When circumstances require ensuring that one eye achieves and maintains dark adaptation, eye patches work well. Eye patches make having one dark-adapted eye possible because each eye dark-adapts separately; one eye can be dark-adapted while the other is not. This individual is wearing a black concave Magic Thimble eye patch and the NEPVS-14 Night Enforcer Gen 3 PINNACLE monocular night vision device (NVD) manufactured by ITT Night Vision, Roanoke, Virginia (USA). Photograph by Miller Photography.

patches are sufficiently inexpensive that one can purchase a flat and concave patch to determine preference.

A secondary use for an eye patch is when looking into the camera viewfinder to focus a high-magnification telephoto lens or telescope. An eye patch also helps when observing the subject through the camera viewfinder for an extended period. Normally, when looking into the camera viewfinder, the surveillance specialist closes the opposite eye, which to an extent impairs visibility because facial muscles are not relaxed. An alternative to placing a hand over the nonviewing eye is to wear an eye patch over that eye. An eye patch contributes to relaxed facial muscles when looking into the camera viewfinder and that enhances viewing. Some astro-photographers wear eye patches for this reason. As one astronomer said, "I would rather wear an eye patch than have a sequenced face all night long!"

Concluding Comment

If photographing from a dark rural area with one dark-adapted eye, the subject is at a disadvantage if emerging from an illuminated area to launch an attack once discovering the surveillance. The subject is especially at a disadvantage if pursuing a team retreating into a wilderness area, the team being dark-adapted. If the pursuit effort lasts long enough for the subject to become dark adapted, and if he gets too close, put on a red-lens dark adaptation goggle to preserve dark adaptation and then illuminate the subject using a high-output handheld spotlight or strobe light. Once illuminated by a flashlight of perhaps 400,000 lumens, from a distance of perhaps 100 meters, the subject will immediately lose dark adaptation and be temporarily blind and disoriented. Remember, the subject is dark adapted when exposed to the light and therefore the rods of his eyes are about 100,000 times more sensitive to light than they were in a lighted area. As a safety precaution, illuminate the subject from behind suitable cover in case he attempts to shoot out the spotlight. Once temporarily blinding the subject, continue evasive efforts.

MEASURES TO MAXIMIZE NIGHTTIME VISION

> Once a bright light neutralizes dark adaptation, approximately 30 minutes is required to reestablish dark adaptation.

The previous section discussed the use of a red-lens dark adaptation goggle and eye patch to achieve and maintain dark adaptation of the eyes. Knowing how to achieve and maintain dark adaptation is important. It is also important to know what to do in terms of lifestyle to ensure the eyes are capable of dark adaptation to the maximum extent possible and to ensure they achieve the dark-adapted state as quickly as possible.

The United States Federal Aviation Administration *Airplane Flying Handbook* (2004, p. 10–2) recommends doing the following things to maximize night vision. Some entries the authors added to the list.

- Maintain good physical condition.
- Wear quality sunglasses during the day–do not wear sunglasses after sunset.
- Adapt the eyes to darkness prior to entering a dark environment.
- Close one or both eyes or, wear a red-lens dark adaptation goggle, or apply an eye patch when exposed to bright lights while working in a dark environment. Do this even when bright light is temporary. Brief

exposure to a bright light neutralizes dark adaptation but approximately 30 minutes is required to reestablish dark adaptation.
- Do not look directly at a bright object. Rather, use peripheral vision.
- Move the eyes more slowly than in daylight.
- If the eyes become blurred, blink them.
- View off-center when in the dark to project the image onto the rods of the eyes.
- Movement towards or away from the observer is the most difficult to detect because "apparent" movement is lacking.

The following conditions are detrimental to achieving dark-adapted vision.

- Drinking alcohol.
- Smoking.
- Drugs-medications.
- Fatigue.
- Colds.
- Deficiency of vitamin A.
- Permitting bright light to overstimulate the rods.
- The thin air and therefore diminished oxygen at high altitudes is detrimental to good night vision. At altitudes over 1,524 meters (5,000 feet), use oxygen if necessary, if oxygen is available.

NOCTURNAL ANIMAL EYES VERSUS HUMAN EYES

In the epilog at the beginning of this chapter, it states, "Human eyes never function as effectively at night as the eyes of animals with nocturnal habits" (Federal Aviation Administration, 2004, p. 10–1). There are several reasons why many nocturnal animals see better at night than humans do. The reasons include:

- Many nocturnal animals have comparatively large eyes that capture more light than human eyes do.
- The eyes of many nocturnal animals feature large diameter pupils that capture large quantities of light.
- The eyes of many nocturnal animals feature a high concentration of retina rods, rods being sensitive to low light.
- A layer of light reflective material called *tapetum lucidum* (te pet′em lüsi-dem) exists behind the retina of the eyes of many nocturnal animals (refer back to Figure 8-1). Tapetum lucidum is Latin for *bright tapestry* or *bright carpet.* Light not captured by rods during the first pass restim-

ulates the rods when reflected back towards the front of the eye. The stimulation of the rods twice, stimulation by both incoming and outgoing light, makes them more efficient for nighttime viewing. The reflective nature of tapetum lucidum makes the eyes of many nocturnal animals highly reflective and that is why they appear to glow when exposed to light. The eyes do not glow–they reflect light.

BINOCULAR

> Surveillance photography may require the use of spotting scopes, telephoto lenses, and binoculars. (Department of the Army, 1993, March 23, p. C-11, FM 31-20-5, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*)

Introduction

Physical Surveillance involves making visual observations from distances that usually exceed the effective range of the unaided eye. Moreover, observations often occur under low-light conditions. It is necessary, therefore, to use appropriate visual aids. Because surveillance distances and lighting conditions vary, one must have an assortment of visual aids, which include high quality binoculars. Regarding the importance of the binocular for low-light viewing, Jim Sapp explains:

> For decades, the 7x50 binocular has been considered to be the standard "night glass," or the binocular used for delivering maximum image brightness in night-time conditions for maritime or military use. This is because the fifty-millimeter objectives collect a lot of light, and the low, 7 power magnification delivers the widest field-of-view, while keeping the exit pupil within a maximum value of 7 millimeters, which is generally considered the maximum diameter that the pupil of the average human eye will dilate to in darkness. That is, the average eye of a young person of average military age! (Sapp, 2003, Spring, n.p.)

Failure to use magnification to extend the range of vision requires moving in dangerously close to a subject to discern important detail or, if working from a safe distance, suffering the inability to discern detail. For example, one cannot read a vehicle number plate from distances much in excess of 30–46 meters (100–150 feet) without the aid of magnification. Each member of a photography team must have suitable binoculars from which to choose based on viewer to subject distance and according to the level of ambient illumination.

Figure 8-5. For physical surveillance, binoculars are the most frequently used visual aid because they are compact, effective, easy to use, and affordable. *Upper image:* Nikon StabilEyes 12x32 VR image stabilized binocular. This waterproof binocular permits reading a vehicle number plate from over 228.6 meters (250 yards) while handholding the instrument during daylight hours. *Lower left image:* The Carl Zeiss Victory FL 8x56 T* binocular is ideal for daytime and nighttime use. This binocular with its 56-millimeter diameter objective lenses gathers more light than any other binocular in the Carl Zeiss Victory FL line. This waterproof binocular, featuring superior physical and optical quality, offers excellent field-of-view and the image is exceptionally clear and bright. *Lower right image:* The Carl Zeiss Victory Compact 8x20 T* binocular folds small enough to carry in the pocket of a shirt or blouse and women can easily carry it in a purse. Although compact, this waterproof binocular provides excellent field-of-view and superior image quality.

A binocular, regardless of its type and features, consists of two prismatic telescope systems mounted parallel to each other (see Figure 8-5). The double viewing system provides an enlarged and stereoscopic view of a distant subject.

Binoculars are the most frequently used visual aid for physical surveillance for the following reasons:

- They are compact, effective, easy to use, and affordable (except for those in the ultra high-magnification large aperture category, which are large, heavy, and expensive).
- They permit making observations using both eyes.

- They feature a variety of magnifications and apertures from which to choose.
- Models intended for low-light use gather considerably more light than does the unaided human eye.

Some binoculars are compact and suitable for intermediate-range daytime use. Others are larger and suitable for low-light and nighttime use. Still others are suited for long range and ultra long-range daytime viewing and some are ideal for long range and ultra long-range low-light viewing. Binoculars range in size from the Zeiss Victory Compact 8x20 T* binocular weighing only 225.10 grams (7.94 ounces) to the massive Fujinon 25x150 MTM military marine ultra high-magnification large aperture binocular weighing 40 kilograms (88 pounds).

Low Cost versus Expensive Binoculars

A familiar axiom states that you get what you pay for and this certainly is true for binoculars. The quality of design, materials, manufacturing methods, quality control during manufacturing, and the manufacturer's commitment to customer service and satisfaction define the value of a binocular. The authors find these qualities in Carl Zeiss binoculars and that is why they use them. There is a reason why Canon and Nikon super telephoto lenses are expensive, and the same reasons underscore why Carl Zeiss binoculars are expensive. They are exceptionally high quality optical systems!

Carl Zeiss Victory binoculars, their highest performing binoculars, are expensive, but they represent excellent value because of superb quality. Nevertheless, for many people and agencies, budget is a concern when purchasing binoculars. If budget is a concern, consider Carl Zeiss Conquest binoculars, which are less expensive.[5]

The authors use the Victory FL 8x56 T* binocular and the Carl Zeiss Victory Compact 8x20 T* binocular and can attest to their superb quality and performance. Not using Conquest binoculars, they submitted an inquiry to Richard Moncrief, Training Manager, Carl Zeiss Optical, Inc., asking about the performance difference between the two binoculars, Victory versus Conquest. The following is the inquiry and reply.

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5. Carl Zeiss Optical, Inc. offers two lines of binocular, the Victory and the Conquest. The Victory is their highest performing binocular. If budget is a concern, consider the Zeiss Conquest series. Conquest binoculars are high quality instruments but less expensive than the Victory binoculars. Carl Zeiss Optical, Inc. offers no low performance optical systems.

> *Question:* If we were to view a subject using the Zeiss Victory FL 8x56 T* binocular and Zeiss Conquest 8x56 T* binocular in turn, would we perceive an optical quality difference and, if so, would the difference be significant?
>
> *Reply:* There is a difference in optical performance. You will especially see this in low light situations. It has to do with color correction of the optics and the resulting image resolution based on how closely the color corrects. This is based on the glass selection for the optics, the types of coating used, and optical design and engineering. The FL's will outperform the Conquest models and it is a noticeable difference but not something easily quantifiable. . . . As for the glass, the types of optical grade glass we use are very expensive, some glass types cost more than gold per ounce depending on the performance characteristics. FL glass is extremely expensive. . . . If you saw what goes into premium lens production, you would be amazed! (Richard Moncrief, personal communication, November 18, 2009).

The authors use the Carl Zeiss Victory FL 8x56 T* binocular, as stated, and they use the Nikon 7442 7x50 Sports and Marine binocular. At the time of this writing, the Zeiss binocular retails for approximately $2,500 (USD) and the Nikon binocular retails for approximately $250 (USD), prices varying by retailer. The performance of the Nikon 7x50 binocular is excellent, but a nighttime side-by-side comparison of the two binoculars revealed that the Zeiss binocular outperforms the Nikon binocular. That finding was expected considering the price difference between the two binoculars.[6] For those who do physical surveillance, the price of the Carl Zeiss Victory FL 8x56 T* binocular represents excellent value and, if treated properly, it will last an entire career. Regarding Carl Zeiss binoculars, veteran police detective and licensed private investigator, Darin Fredrickson, CPP, stated that, "Physical surveillance is about making visual observations to acquire information so why not use a binocular that enhances vision the best?" (Darin Fredrickson, CPP, personal communication, January 6, 2010). Detective Fredrickson serves with a 3,000+-officer police department.

Detective Fredrickson, serving on a six-person surveillance team, uses the Carl Zeiss Victory FL 8x56 T* binocular and the Nikon StabilEyes 12x32 VR image stabilized binocular. When he first obtained the Zeiss Victory FL 8x56 T* binocular, in an e-mail to the authors, he stated, "I just obtained a

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6. Recently, during stakeout, Detective Fredrickson observed his subject leave a market carrying a 12-pack of beer. Using the Carl Zeiss Victory FL 8x56 T* binocular he was able to discern what kind of beer the subject had purchased. His case manager was surprised that he had discerned such detail from the distance at which he made the observation. He explained that the Victory FL 8x56 T* binocular permitted discerning such detail, and added that the binoculars he used earlier in his career would not have permitted discerning such detail.

Zeiss Victory 8x56 binocular. When I first took them outside to have a look my thought was, WOW! The field-of-view and clarity is awesome!"

After he had used the Zeiss Victory FL 8x56 T* binocular a few months for physical surveillance, he was asked when he finds that binocular, versus the Nikon StabilEyes 12x32 VR image stabilized binocular, most appropriate. He offered the following reply.

> In most instances, day or night, I use the Zeiss Victory 8x56 binocular, especially for fast moving situations where I must get an eye on the subject immediately. The large exit pupil enables me to instantly find and hold the sight-picture and field-of-view and image clarity is excellent. The Zeiss provides a brighter and clearer image than any other binocular I have used. At night, I have encountered situations where a subject vehicle parked in the shadows is almost undetectable with the naked eye but with the Zeiss binocular, I was able to read the license plate number. Once set up on stakeout during daylight hours and the situation is stable, I sometimes use the Nikon StabilEyes 12x32 binocular for a closer view for subject ID and to read a license plate number. Once obtaining the information I need from the close-up view, I resume using the Zeiss 8x56 binocular. The main problem I have with the Nikon stabilized binocular is it takes 1–3 seconds to activate the stabilization system and often I do not have 1–3 seconds because I must get the eye on the subject immediately. True, the Nikon binocular offers image stabilization and greater magnification, but the image is not as bright and clear as the image provided by the Zeiss binocular. In my 18-year law enforcement career, I have used many binoculars, some better than others, but none compared with the Zeiss binocular I am now using. I strongly feel that every detective should be using the Zeiss Victory 8x56 binocular for daytime and nighttime physical surveillance. It makes sense–physical surveillance is about making visual observations to acquire information so why not use a binocular that enhances vision the best? (Darin Fredrickson, CPP, personal communication, January 6, 2010)

Magnification and Objective Lens Diameter

> Objective lens diameter "combines with magnification, exit pupil, type of coating and type of prism to determine overall light transmission efficiency." (Carl Zeiss Optical, Inc., n.d., n.p., *Objective Lens Diameter*)

When examining binoculars, one will observe two numbers printed on the instrument, an "x" separating the two numbers. The first number indicates the magnifying power of the binocular and the second number indicates the diameter of the objective lenses measured in millimeters (see Figure 8-6). On many binoculars, one will see the numbers 7x50 for example. The number seven preceding the "x" identifies the magnification of the instru-

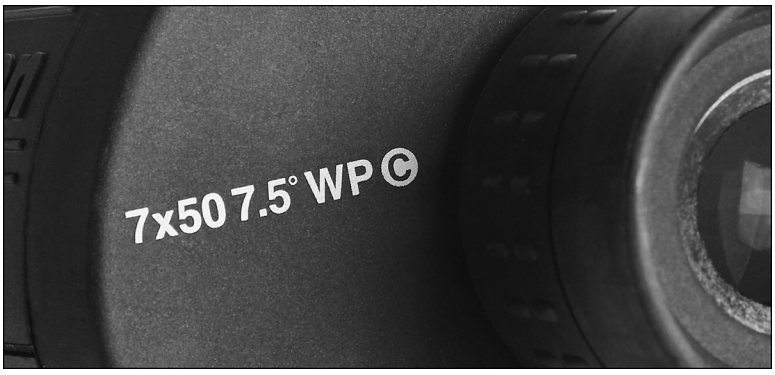

Figure 8-6. An "x" separates the two numbers that identify the specifications of a binocular, a 7x50 binocular in this example. The first number, seven, identifies the magnification of the binocular. The second number, fifty, identifies the diameter of the objective lenses measured in millimeters. This binocular features a 7.5° angle-of-view, that information not always reflected on a binocular as it is in this example.

ment. The second number, fifty in this case, identifies the diameter of the objective lenses measured in millimeters. An object viewed through a 7x (seven-power) binocular appears seven times larger than when viewed with the unaided eye. The image being seven times larger appears to be seven times closer.

Erecting Prisms

Binoculars feature a prism system that provides two benefits. First, the prism system causes light passing through the binocular to travel a circuitous route. The result is a high degree of magnification in a comparatively small size instrument. Second, the prism system erects the image so that the viewer sees it as upright and correct left-to-right. That is why binocular prisms are called *erecting prisms.*

Binoculars feature *Porro prisms* or *Roof prisms.* Roof prism binoculars are unique in appearance because of the "H" shape resulting from the objective lenses and eyepiece lenses being in-line. There are several types of roof prisms with ZEISS' Abbe-König roof prism providing the highest degree of light transfer. Porro prism binoculars are recognizable by their offset objective and eyepiece lenses, which results in the classic two-stage profile (see Figure 8-7).

Most binoculars feature either BAK-4 (barium crown) prism glass or BK-7 (borosilicate) prism glass. BAK-4 prisms virtually eliminate internal light loss making a sharp and well-defined image possible. Only low cost binoculars feature BK-7 prisms.

Figure 8-7. The Carl Zeiss Victory FL 8x56 T* binocular on the left feature *Roof* prisms. Observe that the objective lenses and eyepiece lenses are in line resulting in the "H" shape characteristic of Roof prism binoculars. The Nikon 7442 7x50 Sports and Marine binocular on the right feature *Porro* prisms. The objective lenses and eyepiece lenses are not in line; they are off set.

Coating of Optical Surfaces

Carl Zeiss uses "T*" to designate their multi-coating system and they use "FL" to symbolize fluoride glass. Zeiss manufactures their FL glass without using arsenic and toxic lead.

There are between 10 and 16 optical surfaces in a binocular, depending on the optical design of the instrument. Proper coating of optical surfaces reduces light loss and thus permits utilizing more of the light entering the instrument. Today, a high-performance binocular will pass as much as 90-95 percent of the light entering the instrument. Properly coated quality optics provides a bright crisp image. The four levels of antireflection optical coatings are:

- *Fully Multicoated:* Several layers of coating exist on all air-to-glass surfaces. This is the most desirable inasmuch as it results in the least amount of light loss and therefore the brightest and sharpest image.
- *Multicoated:* All air-to-glass surfaces feature at least one coating with one or more surfaces featuring several layers of coating, those usually being the objective lenses and eyepiece lenses. Binoculars featuring multicoated optics tend to perform well.

- *Fully-Coated Optics:* A single layer of coating exists on all air-to-glass surfaces. This is found on low cost binoculars and can provide reasonably good performance.
- *Coated Optics:* One layer of coating exists on the front surface of the main objective lens and usually also on the eyepiece lens, but not necessarily the latter. This is the lowest quality coating and does not result in a quality binocular.

For investigative and tactical applications, use only *fully multicoated* and *multicoated* binoculars. Realize, however, that the lens coating specifications for some high-performance binoculars do not use the terminology identified here. Nevertheless, exceptional quality exists and the consumer can purchase the binoculars with confidence. One example is Carl Zeiss binoculars. Carl Zeiss Optical, Inc. explains that, "Zeiss' two proprietary anti-reflective coatings are called T* and MC multicoating. An additional Zeiss-exclusive coating, P* Phase Correction Coating, is applied to Roof Prisms to correct color fringing" (Carl Zeiss Optical, Inc., n.d., n.p. *Coatings*).

The Carl Zeiss Victory FL 8x56 T* binocular with its 56-millimeter diameter objective lenses gathers more light than any other binocular in the Carl Zeiss Victory FL line. The Nikon 7442 7x50 Sports and Marine binocular provides a 95 percent light transmission.

Large Aperture Binoculars: Binoculars for Low-light and Nighttime Use

A 7x50 binocular, which is ideal for nighttime use, gathers approximately 50 times more light than does the unaided human eye. An 8x56 binocular gathers approximately 64 times more light than does the unaided human eye. Unfortunately, the eyes of almost nobody over age 30 have a 7-millimeter pupil. A 5-millimeter pupil is average for people over age 40. For people over age 40, an 8x40 binocular will deliver all the light their eyes can use.

All quality binoculars are suitable for daytime use if the degree of magnification is appropriate for the observer to subject distance. Conversely, not all binoculars are appropriate for low-light and nighttime use. To be useful for nighttime use, a binocular must feature an exit pupil as large as the pupil of the observer's eye when fully dilated, which, for a young person, is approximately 7 millimeters.

Magnification and objective lens diameter determines the size of the exit pupil of a binocular. The quickest way to determine if a binocular is suitable for low-light use or nighttime use is to divide the diameter of the objective

Table 8-1.
BINOCULAR SUITABILITY BY LEVEL OF ILLUMINATION

Illumination	Exit pupil diameter
Daytime	2–4 millimeters
Low-light	5–6 millimeters
Night	7 millimeters

Figure 8-8. Magnification and objective lens diameter (aperture) determine the diameter of a binocular exit pupil. *Upper image:* 2.5-millimeter exit pupil of an 8x20 binocular (20 ÷ 8 = 2.5). *Lower image:* 7.14-millimeter exit pupil of a 7x50 binocular (50 ÷ 7 = 7.14).

lens by the magnifying power of the instrument. The quotient is the diameter of the exit pupil. An exit pupil diameter of 5-6 millimeters is suitable for low-light use while an exit pupil diameter of no less than 7 millimeters is required for nighttime use (see Table 8-1 and Figure 8-8).

Generally, people familiar with binoculars think of large aperture binoculars as a low-light binocular and small aperture binoculars as a daytime binocular. Relative to most circumstances, they are correct. During daylight hours when the light gathering ability of a large aperture binocular is not necessary, the small size and low weight of a small aperture binocular is an appealing feature. Nevertheless, for many daytime tactical applications, a large aperture binocular serves best.

Large aperture binoculars with their large diameter exit pupil permit quickly finding and holding the sight picture. Moreover, large aperture binoculars minimize the problem of image blackout when making observations from a moving platform. Image blackout occurs when the light exiting the binocular does not enter the pupil of the observer's eye. During daylight hours, a large aperture binocular permits considerable binocular/eye misalignment before image blackout occurs. That is why, during the day, large aperture binoculars such as 7x50 and 8x56 serve best during physical surveillance operations.

Ultra-High-Magnification Binoculars

> *Long-Range Surveillance.* Direct observation and reporting on targets such as activities and facilities may provide timely and accurate intelligence to support a decision or cross-cue other collection capabilities. Long-range surveillance (LRS) is often employed when discreet observation of an activity is necessary over a long period of time or when a collection system that can respond to redirection is necessary. (FM 2-22.3. 2006, September 6, pp. 5-9–5-10, *Human Intelligence Collector Operations*)

> Use of visual observation aids (binoculars, scopes, cameras) and thermal or infrared devices increase the SFOD's [Special Forces Operational Detachment's] standoff distance and lessens the risk of compromise. Poor weather or heavy vegetation may require the SFOD to use multiple sites to achieve constant observation. (FM 31-20-5, 1993, March 23, p. 3–21, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*)

Introduction

Ultra-high-magnification binoculars make quality visual observations possible from distances precluding visual detection by the subject. Binoculars

in this class are useful for some urban surveillance applications, but they are essential for rural surveillance. Rural surveillance usually features considerable observer-to-subject distances, the great distances requiring substantial magnification. High magnification makes a binocular support system necessary because even slight movement of the binocular degrades image quality thus defeating the benefit of high magnification.

Ultra-high-magnification binoculars are essential for the observer when the surveillance specialist uses ultra-high-magnification lenses for photography. Recall that the specialist can record detail such as subject identification (i.e., facial recognition) and legible vehicle number plates from distances up to and exceeding 1.61 kilometers (1 mile).

This discussion addresses and illustrates three high-magnification binoculars suitable for clandestine operations. The three binoculars, in order of presentation, are:

- Celestron SkyMaster® 25x100 Binocular, a comparatively lightweight low cost but good performing binocular.
- SkyHawk® 25/40x100 binocular, a high performing and more costly binocular.
- Fujinon 25x150 MTM military marine binocular, an expensive high-performance military binocular available to civilians.

Celestron SkyMaster® 25x100 Binocular

The Celestron SkyMaster 25x100 is a low cost and comparatively lightweight ultra high-magnification binocular (see Figure 8-9). This 25x magnification binocular is useful when high magnification is necessary, but magnification greater than 25x is not necessary.

This waterproof binocular features 100 millimeters (3.94 inches) diameter multicoated two-element (doublet) achromatic lenses and BAK-4 (Barium Crown Glass) Porro prisms. The 4-millimeter exit pupil diameter makes this binocular useful during daylight hours and during the hours of darkness when the subject area features sufficient artificial illumination. High magnification makes a support system necessary because even slight movement degrades image quality thus defeating the benefit of high magnification. The binocular features a built-in tripod adapter. *Dimensions (L/W/H):* 40.64 x 25.40 x 11.68 centimeters (16.00 x 10.00 x 4.60 inches). *Weight:* 4.45 kilograms (9.81 pounds).

Figure 8-9. The Celestron SkyMaster 25x100 ultra-high-magnification large aperture binocular features objective lenses measuring 100-millimeters in diameter. This binocular permits reading vehicle number plates from distances of 0.536 kilometer (0.33 mile) under appropriate atmospheric and lighting conditions. At 4.45 kilograms (9.81 pounds), this binocular is manageable for in-vehicle use by means of a reasonable support. One detective positions the back of the passenger seat forward and rests the binocular on the headrest. The digital single-lens reflex camera is included for size reference; this binocular is relatively large.

SkyHawk 25/40x100 Ultra-High-Magnification Large-Aperture Binocular

Dean-Martin Enterprises, LLC marketed this straight through eyepiece SkyHawk 25/40x100 binocular (see Figure 8-10). At the time of this writing, Dean-Martin Enterprises, LLC offers only a 45-degree angled eyepiece model. Angled eyepieces are ideal for astronomers looking at heavenly bodies, but straight through eyepieces are better suited for terrestrial viewing (i.e., physical surveillance).

At the time of this writing, Oberwerk Corporation offers a near identical binocular as that illustrated here, a binocular featuring straight through eyepieces. Nevertheless, not having examined the Oberwerk model, the authors

Figure 8-10. The SkyHawk 25/40x100 ultra-high-magnification large-aperture binocular features a magnification choice of 25x and 40x. Each user must decide how creative to be when devising a method for using this binocular from within a vehicle. The inset image shows the binocular on a small tripod sitting on a platform over the passenger seat of the vehicle. The inset image is from the book Fredrickson and Siljander, 2004, *Street Drug Investigation: A Practical Guide for Plainclothes and Uniformed Personnel.* Springfield, IL: Charles C Thomas, Publisher, Ltd.

cannot comment relative to improved or diminished quality although the reported specifications remain unchanged.[7]

The SkyHawk 25/40x100 binocular features double eyepiece lenses on rotating turrets that provide a magnification choice of 25x and 40x. The binocular features 100 millimeters (3.94 inches) diameter fully multicoated three-element (triplet) apochromatic objective lenses and BAK-4 (Barium Crown Glass) Porro prisms. Unfortunately, this binocular is not O-ring

7. Not all 25/40x100 binoculars feature fully multicoated lenses and BAK-4 Porro prisms. Some models, although they look the same, feature only multicoated lenses and BK-7 Porro prisms. At least one online retailer offers the lower performing model while asking over twice the price of the better models. Compare technical specifications and price before buying!

sealed and nitrogen-purged to make it water-resistant. This binocular must remain dry during inclement weather use.

The exit pupil diameters of 4 millimeters at 25x and 2.5 millimeters at 40x make this binocular a daytime use instrument. Nevertheless, the binocular performs well during the hours of darkness when the subject area features sufficient artificial illumination.

This binocular is large and heavy, the weight being sufficient to require a support system. Moreover, because of the high degree of magnification this binocular provides, especially at 40x, small vibrations cause severe image degradation. Therefore, ensuring stability of the binocular during use is essential. *Dimensions (L/W/H):* 64.77 x 25.10 x 13.18 centimeters (25.50 x 9.88 x 5.19 inches). *Weight:* Binocular–12.02 kilograms (26.50 pounds). Tripod–7.26 kilograms (16 pounds). Total weight–19.28 kilograms (42.50 pounds).

Performance of this binocular is excellent. One of the authors, with Detective Fredrickson, evaluated the daytime and nighttime performance of this binocular. The following is a brief summary of findings:

- **Daylight hours**. *Distance:* 6.4374 kilometers (4 miles). Using the 40x eyepieces with appropriate atmospheric conditions, if one knows the subject and his or her vehicle, it is possible to watch for their arrival or departure from this great distance.
- **Daylight hours**. *Distance:* 1.207 kilometer (0.75 mile). Using the 40x eyepieces reading vehicle number plates was possible. The distances from which the viewer can discern fine detail increases and decreases according to atmospheric conditions. Near ground thermal activity (heat waves), for example, are a relentless limiting factor when making observations from long distances.
- **Dusk**. *Distance:* 0.4023 kilometer (0.25 mile). Using the 25x eyepieces, which provide a 4mm exit pupil diameter, vehicle number plates were discernable well into dusk without the benefit of artificial illumination.
- **Late night**. *Distance:* 0.4023 kilometer (0.25 mile). *Subject location:* Pump island area of a gasoline service station/market. Using both the 25x and 40x eyepieces subject identification was excellent with vehicle number plates easily read.
- **Late night**. *Distance:* 0.8047 kilometer (0.50 mile). *Subject location:* Pump island area of a gasoline service station/market. 25x magnification was inadequate. The 40x eyepieces provided excellent subject identification, but vehicle number plates were discernable only some of the time. Contrast between the numbers/letters and the background color of the plate and the extent to which artificial light illuminated the

Figure 8-11. The Fujinon 25x150 MTM military marine binocular, designed for permanent installation upon watercraft, permits making quality long-range low-light observations. This binocular is suitable for other military and law enforcement applications. *Note:* The authors have not personally evaluated this binocular. Image courtesy of Fujinon USA, Inc.

number plate determined the degree of legibility. Readability diminished for number plates slightly recessed in the vehicle bumper; that sometimes interfered with illumination of the plate. When the vehicle lights were on and therefore the number plate was illuminated, the numbers and letters were discernable.

Fuginon 25x150 MTM Military Marine Binocular

The Fuginon 25x150 MTM military marine binocular is an impressive and imposing optical instrument (see Figure 8-11). This binocular measures 88.1 centimeters (34.69 inches) in length, 61.8 centimeters (24.33 inches) wide, and it weighs 40 kilograms (88 pounds). With the pedestal, it weighs

60 kilograms (132 pounds). Its 6mm exit pupil diameter makes this binocular well suited for low-light use.

Fuginon, Inc. designed the 25x150 MTM military marine binocular for permanent installation upon watercraft (e.g., Navy warships and Coast Guard cutters).[8] Nevertheless, this binocular is suitable also for other military and law enforcement applications, specifically long-range low-light observation. Fujinon provides a tripod for this binocular that is reminiscent of the tripods used for astronomical telescopes. The tripod permits field use of this binocular whether observing from within a building or a rural wooded area, for example.

This heavy-duty waterproof and fogproof binocular features fully multicoated ED glass lenses and BAK-4 Porro prisms. Protective glass elements protect the front of the objective lenses of the military model. The individually focusing eyepieces feature 18.6 millimeters eye relief and 6-millimeter diameter exit pupils. The exit pupil size makes this binocular suitable for low-light use (refer back to Table 8-1). This binocular angle-of-view is 2.7-degrees and the field-of-view is 47 meters at 1,000 meters (141.4 feet at 1,000 yards).

Civilians may purchase this military binocular, although civilian versions are available. Because the civilian versions do not possess some of the military features, they are less expensive. The civilian versions, for example, feature no protective glass elements in front of the objective lenses and neither do they feature the stainless steel yoke mount and pedestal base.

At the time of this writing, B & H Foto & Electronics Corporation sells the military version with the stainless steel yoke and pedestal base for $17,256.50 (USD). B & H sells the civilian version, the Fujinon 25x150 EDMT-SX, without a mounting system, for $9,993.95 (USD).

Image-Stabilized Binoculars

> . . . high power, gyro-stabilized binoculars, which can be used from a moving vehicle . . . gives the team another surveillance and collection device. (*U.S. Army Field Manual* No. 2-0, 2004, May 17, p. 11–11, *Intelligence*)

Wikipedia, the free encyclopedia, provides an accurate and succinct description of image-stabilized binoculars. Wikipedia (2009, July 5, n.p., *Image-stabilized binoculars*) reports that:

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8. Today, "a cutter is any Coast Guard vessel over 65-feet in length" (United States Coast Guard, Department of Homeland Security, 2008, December 9, n.p., *What Is a "Cutter"?*).

> Image-stabilized binoculars are binoculars that have a mechanism for decreasing the apparent motion of the view due to binocular movement. Image-stabilized binoculars are designed to minimize image shaking in handheld binoculars. Higher power binoculars bring the image closer, but the image shift is also greater with even smaller movement of your hands. Image stabilization technology in binoculars ensures instant adjustment of the image to compensate for the motion.

For many surveillance applications, image-stabilized binoculars are desirable because they reduce the effects of hand tremors (refer back to Figure 8-5, upper image). Moreover, image-stabilized binoculars provide a stable image when used from a moving land vehicle, watercraft, or aircraft. Some image-stabilized binoculars require batteries while others do not.

Most image-stabilized binoculars are in the high-magnification category. Unfortunately, their small diameter objective lens relative to their magnifying power results in a comparatively small diameter exit pupil. For that reason, they perform well during daylight hours but not under low-light conditions. Realize, however, stated previously, that sufficient artificial illumination levels can make nighttime use of daytime optics feasible. Case in point, the Nikon StabilEyes 12x32 image stabilized binocular with its small 2.67-millimeter diameter exit pupil works well at night with, for example, parking lot lights illuminating a subject.

Zeiss offers the 20x60 S Image Stabilization Binocular, an expensive but very high-performing optical system. Canon, Nikon, and Fujinon offer an assortment of image-stabilized binoculars with the degree of stabilizing compensation varying by brand and model.

Laser Protection Filters

Some military binoculars feature laser protection filters to protect the observer's eyes. Unfortunately, the filters can reflect direct sunlight (FM 23-10, 1994, August 17, p. 2-40, *Sniper training*). To prevent a subject becoming aware of the surveillance by virtue of light reflection, apply antireflection devices (ARDs) to the objective lenses when necessary. Chapter 3 provides a comprehensive illustrated discussion of ARDs.

Binocular Selection

When selecting a binocular, be alert for the following features.

- Waterproof/Fogproof–Nitrogen filled and O-ring sealed.
- Fully multicoated or multicoated optical system (fully multicoated is best, but multicoated is good).

- BAK-4 (barium crown) prism glass virtually eliminates internal light loss making a sharp well-defined image possible. Only low cost binoculars feature BK-7 (borosilicate) prisms.
- Long eye relief is desirable if the user wears corrective lenses (eyeglasses). Those who do not wear eyeglasses should avoid long eye relief.
- Exit pupil diameter no less than 7 millimeters for nighttime use (refer back to Table 8-1 and Figure 8-8).
- Select a product made by a manufacturer known for offering quality products. Place equal emphasis on the manufacturer's commitment to customer service.
- When planning the purchase of a binocular, realize that for marketing purposes some manufacturers offer both low cost and professional grade binoculars. Select from among their professional grade products. Realize also that the low-end binoculars provided by some manufacturers are equal to or better than high-end binoculars offered by other manufacturers.

SPOTTING SCOPE

Prismatic telescopes, commonly referred to as spotting scopes, are useful for physical surveillance. They are compact and the magnification they offer satisfies most physical surveillance needs. Compactness is the result of a prism system that folds the optical path in a manner characteristic of binoculars. Some spotting scopes feature a Porro prism and some feature a Roof prism.

Spotting scopes range from low cost models to expensive professional grade models. The adage, "You get what you pay for" is true; use a high quality spotting scope made by a manufacturer known for quality optics. The United States military and the authors use the Leupold Mark 4 12-40x60 Tactical Spotting Scope, a high quality instrument ideally suited for use by clandestine photography teams (refer to Figure 3-5 in Chapter 3).

Spotting scopes, like binoculars, feature objective lenses of varying diameter. The size of the objective lens is important when using the scope at high magnification or when using it under low-light conditions, or both. Objective lens diameters of 50, 60, and 80 millimeter are common with the Carl Zeiss Victory DiaScope 85 T* FL featuring an 85 millimeter objective lens. Some low cost spotting scopes feature an objective lens measuring 100 millimeters in diameter.

Spotting scopes, just like any high-magnification optical system, amplify vibrations. For that reason, using a tripod or some other suitable support is

important. Securing the scope becomes increasingly important as the magnification of the instrument increases.

For security purposes, use a refractive not reflective (mirror) spotting scope; Schmidt-Cassegrain spotting scopes are available. The reason for this is that refractive lenses pass light, while reflective (mirror) systems reflect light. The authors experimented with this by placing two tripod mounted spotting scopes next to each other. One was a large aperture (100mm) refractive scope and the other was a 5-inch (127 mm) reflective (Schmidt-Cassegrain) spotting scope. Both scopes faced building-mounted security lights in the distance. When viewing the scopes from the vicinity of the light source, the reflective lens was considerably more visible than the refractive lens. Nevertheless, the refractive scope justified use of an antireflection device (ARD). Chapter 3 provides an illustrated discussion of ARDs.

TELESCOPE

When using a telescope for terrestrial viewing, use a 45-degree or 90-degree correct-image prism diagonal to view an upright image.

When the observer-to-subject distance exceeds the effective range of a high-magnification binocular or spotting scope, the observer must use a telescope. Recall that the surveillance specialist can photographically record subject identification (i.e., facial recognition) and legible vehicle number plates from 1.609 kilometers (1 mile) or more. When photographing from such extreme distances, the observer needs suitable magnification.

When viewing the subject from a distance of 0.805 kilometer (0.5 mile) or more, using a reflective telescope often is permissible because of the cover provided by distance. Nevertheless, use of an antireflection device (ARD) is sometimes necessary. Detection by virtue of light reflections is unlikely when the photography team is located in a visually cluttered urban environment wherein light reflections are common and expected. Conversely, a light reflection observed in an unpopulated rural area indicates human presence.

IMAGE INTENSIFIER NIGHT VISION DEVICE

Image intensifier night vision devices (NVDs) are electro-optical instruments that provide humans with night vision by means of light amplification. Refer to Chapter 5, *Night Vision Photography for Clandestine Operations.*

Chapter 9

MISCELLANEOUS TOPICS

Legal Issues–Speechreading–Hiring a Photo Specialist–Renting vs. Owning Equipment–Custom Fabrication of Specialty Products

INTRODUCTION

This chapter features miscellaneous topics of importance that are not sufficiently consistent with the topics of other chapters to appear elsewhere in this book. Additionally, each discourse featured here is too short to appear as a stand-alone chapter. For those reasons, this heterogeneous chapter is necessary.

This book discussed and illustrated the equipment and methods of manual clandestine photography with little regard for legal issues. The emphasis was on how to do it, not when doing it is legal. Because clandestine photography occurs in a complex legal environment, the surveillance specialist must know the laws of their jurisdiction. This chapter provides an overview of laws and legal theories pertaining to manual clandestine photography in the United States, the discourse contributed by attorney Ron Hankin who brings his investigative and legal background to bear on the topic.

Following discussion of legal issues, this chapter addresses the esoteric subject of speechreading. This topic is important because skilled speechreaders can assist in the acquisition of evidence and intelligence by studying surveillance video and decipher much of what the parties to a conversation said.

Discussion then proceeds to the question of when retaining the assistance of a clandestine photography specialist is necessary. Sometimes a case requires photography under particularly challenging circumstances, situations requiring equipment and/or technical expertise that are not available in-house. When that occurs, retaining the services of a specialist may be necessary. A specialist may furnish and operate equipment that the agency needs

for the operation or the specialist may simply identify what equipment the agency needs in order to photograph under the circumstances. In other instances, the specialist assists the field team getting set up with appropriate equipment and after brief indoctrination leaves them to do the photo surveillance. This chapter addresses this topic.

Because of the high cost of some equipment or because of infrequent need, or because certain equipment can become obsolete in a short time, renting certain products is sometimes preferable to owning them. This chapter provides the reader with things to consider when making a rent versus purchase decision.

Finally, this chapter discusses the need to fabricate specialty products in-house. The serious surveillance specialist needs some equipment that is too specialized to survive on the commercial market and therefore it is not available. As a result, the specialist must decide whether to manage without the product, fabricate it in-house, or hire a fabrication shop to make it.

MANUAL CLANDESTINE PHOTOGRAPHY AND THE LAW

By

RON HANKIN, ESQUIRE

Author's Prelude

Ron Hankin, attorney, private investigator, commercial pilot, author, former FBI Special Agent, and U.S. Marine Major generously contributed the following dissertation.[1] Ron Hankin's treatise addresses primary legal issues pertaining to physical surveillance and to manual clandestine photography during surveillance operations. This treatise is important because throughout this book, the authors discuss the surreptitious photographing of people without regard for when photographing is legal. Stated another way, this book explains how to do it, not when doing it is legal.

Surveillance specialists must understand the legal environment within which they operate. Knowing the law is important, especially in view of the extreme distances from which photographing a subject is possible during daylight hours and at night. To be sure, the ability to record detailed photographic images from extreme distances carries with it the ability to infringe

1. Hankin, R. (2009). *Navigating the legal minefields of private investigations: A career-saving guide for private investigators, detectives, and security police.* Flushing, NY: Looseleaf Law Publications, Inc. Website: www.Looseleaflaw.com. Telephone: 800.647.5547.

upon a subject's legally protected right to privacy. Failure to know the law can result in unwittingly violating the law and suffering criminal prosecution or a civil lawsuit, or both.

Violation of the law can result in unsuccessful prosecutions–courts do not accept illegally obtained evidence. Moreover, if the illegally obtained evidence leads to other evidence, a court may exclude that evidence under the Fruit of Poisonous Tree Doctrine. Finally, stated above, violating a legally protected right to privacy can result in the specialist answering to criminal charges or a civil lawsuit, or both.

Ron Hankin's discourse addresses key legal issues, but it does not eliminate the need for competent legal council relative to the laws in each surveillance specialist's jurisdiction. Knowing the laws is essential and in some instances, legal council is necessary regarding a case specific issue (e.g., "This is what we must to do in order to record photographic images of the subject. Can we legally do this?"). Each specialist is responsible for knowing the laws that govern their activities, and they are responsible for seeking competent legal council on an as needed case-by-case basis.

Legal Considerations of the Simple Photograph

The right to privacy is not mentioned in the U.S. Constitution. The right arises from federal and state court interpretations of the document's Fourth Amendment prohibition against unreasonable governmental search and seizure. Since the term "search" includes photographs (to include still photos, videos, cell phone images, and the like) taken by law enforcement officers (LEO's), any snapped picture which will see the light of day must pass muster with the Fourth Amendment (intelligence gathering vs. evidence is left for another day).

In 1967, the U.S. Supreme Court held that privacy protection extends to the subject's reasonable expectation of privacy, not the physical place in which the act occurred (*Katz v. United States,* 389 U.S. 347). *Katz* is still the law of the land and as such is cited continuously by federal and state courts. While the facts of *Katz* do not specifically include photographs, video, or the use of scopes, the proposition has broadened as authority to include any search. (Footnote 1) Therefore, unless a government operative has a warrant or an applicable exception to the requirement that he have a warrant, the subject has a shield of privacy for action, even an illegal action, he reasonably expects private at that moment in time–regardless of the physical setting. (Warrant exceptions are numerous, vary by jurisdiction, and are discussed in much greater detail in the author's book, *Navigating the Legal Minefields of Private Investigations,* Looseleaf Law Publications, Inc., 2008.)

Note that the Fourth Amendment prohibition against unlawful search is applicable only to government agents including law enforcement; whereas, private investigators and security personnel not in concert with the government personnel are not so bound. (Footnote 2) What all this means is that a photograph procured by an LEO with intent to use same as evidence in a court of law against an accused must be procured with a warrant, or warrant exception, or taken under circumstances in which his subject has no reasonable expectation of privacy–a non-search. (Footnote 3)

The Reasonable Expectation of Privacy

It is not always easy for the LEO to gauge whether street circumstances present his subject with a reasonable expectation of privacy for illegal actions. And there are scant safe harbors. Here are two:

1. Generally, courts agree that an act exposed to the public negates a claim of a reasonable expectation of privacy. That is, such observation or photographic image is a non-search. In other words, no Fourth Amendment warrant or warrant exception is needed to observe or capture the image on film or video. Said the Court in *Katz:*

> {W}hat a person knowingly exposes to the public, even in his own home or office, is not a subject of Fourth Amendment protection. . . . But what he seeks to preserve as private, even in an area accessible to the public may be constitutionally protected. . . .

2. An act viewed from a place the operative "has a right to be" diminishes or negates a claim of a reasonable expectation of privacy. A place the operative has a right to be is not limited to the public way, and may include certain semi-private venues. Under many circumstances, the operative can take pictures from property that is private–even when accessed by trespass. We must remember *Katz* stands for the proposition that the subject's claim of privacy is based on his reasonable expectation, not the physical location in which the observation or photograph is made. Thus, a photograph taken from a place in which other persons with lawful access could have taken the same photograph had they chosen to do so diminish or negate a claim of a reasonable expectation of privacy. *Katz* usually requires the LEO or his legal advisor make a judgment call: in his jurisdiction, will privacy protection extend to a company outing on a rented yacht, most probably, no; or to a family gathering in a public banquet hall when the door is closed, most probably, yes. So we see that circumstances drive the reasonableness of the expectation, but it is quite a slippery slope. The LEO must always err on the side of privacy protection.

Scopes and Photographic Equipment

The Fourth Amendment and *Katz* limit a lawful observation to that which the operative could see with his natural eyesight had he gone to the limit of a place "he has a right to be." As discussed, the term "he has a right to be" is interpreted to mean more than the public way. The journey might, for instance, bring him to the edge of the subject's lot line, where the operative could observe and film those activities exposed to the public and third persons such as a neighbor. Binoculars, zoom-camera and camcorders ("scopes") present a wonderful opportunity for the LEO and private operative to view and photograph for evidentiary purposes; however, with such efficiency comes caveats. Scopes can easily convert a lawful view into one that is intrusive. In one such a case, officers peered into an office on the 8th floor of an office building. They were there to observe a meeting of suspects involved in a plot to distribute illegal pornographic movies. The office window had no drapes but was beyond the visual reach of the officers with natural eyesight because of a deep gully which separated the hill on which they stood from the office window. They could get no closer. However, using a ten-power scope the officers could read the logo on the movies being passed around the table which they immediately recognized as illegal porn. This view provided the probable cause needed for a search warrant; and the office was raided. The conspirators were charged, but at trial, the search warrant and evidence so procured were suppressed. The court held the police view was a violation of the Fourth Amendment. Said the court:

> We start then with *Katz v. United States,* {in which} the high court declared: "(T)he Fourth Amendment protects people, not places. What a person knowingly exposes to the public, even in his own home or office, is not a subject of Fourth Amendment protection. But what he seeks to preserve as private, even in an area accessible to the public, may be constitutionally protected."
>
> . . . We thus view the test of validity of the surveillance as turning upon whether that which is perceived or heard is that which is conducted with a reasonable expectation of privacy and not upon the means used to view it or hear it. So long as that which is viewed or heard is perceptible to the naked eye or unaided ear, the person seen or heard has no reasonable expectation of privacy in what occurs. Because he has no reasonable expectation of privacy, governmental authority may use technological aids to visual or aural enhancement of whatever type available. However, the reasonable expectation of privacy extends to that which cannot be seen by the naked eye or heard by the unaided ear. While governmental authority may

> use a technological device to avoid detection of its own law enforcement activity, it may not use the same device to invade the protected right.
>
> Here the activity seen through {the} ten-power binoculars within suite 804 was not observable to anyone not using an optical aid. It was as much protected from the uninvited eye as was Katz's conversation from the uninvited ear. We hence conclude that the municipal court erred in denying defendants' motion to suppress the product of {the} observations.
>
> *People v. Arno,* 153 CalRptr 624 (Cal 1979)

When the scope provides a view the operative could not have had with his natural eyesight from a place he has a right to be, suspect a Fourth Amendment violation–unless there is a warrant or warrant exception. However, when the scope only brings closer what the operative could see with his natural eye had he bothered to walk to the limit of a place he or a third person such as a neighbor had a right to be, the expectation of privacy becomes unreasonable. The scope has merely brought the scene closer.

In one case, law enforcement officers sat in their squad car some distance from another vehicle occupied by two men. The scene was a public park where alcohol was prohibited but where there had been numerous complaints of rowdy behavior by drunks. The officers used binoculars to watch the men and saw that they were drinking beer. Arrested and charged, the men defended, claiming use of binoculars by police made the observation of their activities a Fourth Amendment violation. The court disagreed. The officers could have gone closer and used their natural eyesight to make the same observation but, for tactical reasons, chose not to do so. Said the court:

> The sole issue is whether the observation of the activities in the car with the aid of binoculars was prohibited by the United States or State Constitutions? It was not. The use of binoculars to view what is otherwise visible violates neither the Fourth Amendment nor its counterpart {our state} constitution.
>
> The rule is that: Fourth Amendment restrictions should not be imposed when the police have done no more than: (1) use binoculars to observe more clearly or carefully that which was in the open and thus subject to some scrutiny by the naked eye from the same location; or (2) use binoculars to view at a distance that which they could have lawfully observed from closer proximity but for their desire not to reveal the ongoing surveillance.
>
> In performing their peace keeping duties, the officers had a right to be where they were and also the right to act on what they saw. Neither their

> observations nor their subsequent approach to defendants' car violated any reasonable expectation of privacy.
>
> *State v. Jones,* 653 P2d 1369 (Wa 1982)

There is authority that an off-the-shelf camera with zoom lens of modest enlargement power does not present the privacy issues, which more power might. The view is not materially enhanced beyond what the natural eye can see. In commenting on the use of a three-power camera, one court said:

> The photographs {taken} as evidence in this case . . . merely recorded what could be seen and had been seen without the camera. A 135 mm lens does not shed light into darkness and provides only modest enlargement, not more than three times normal vision.
>
> *State v. Louis,* 672 P2d 708 (Or 1983).

Other Considerations

(1) **Trespass:** In most jurisdictions, it is a criminal offense to trespass onto lands of another person when the property has either been posted or there exists prior warning to stay off. These infractions may well result in fine but may have little to do with the validity of the photograph. While trespass is never advised, especially onto the subject's property, trespass does not make an otherwise reasonable view unreasonable. Even when the trespass takes the operative into an open field owned by the subject, the trespass has been deemed harmless (the so-called "open field" exception to the requirement of a warrant). The observation so procured is not considered an illegal search unless the view is into curtilage which the owner has taken steps to shield from view.

(2) **Living and Restricted Space:** Postings or prior warning are not necessary to prove trespass into:

Living space: Without a warrant, do not enter a home except with permission of an adult owner or leaseholder following a clear and truthful statement of identity and intention.

Private curtilage: private space around the home, indicated as private by location or fencing, which is not visible to the public or neighbors, is off-limits to viewing or cameras. An exception carved out in the law is a brief overflight by those in an aircraft at a lawful altitude.

Restricted areas: Any location where custom or clear and present danger make it obvious to a reasonable person that access to the area is restricted must be avoided; for example, abortion clinics, ammunition arsenals, in the back-door of a currency exchange, or government installations. Stay out.

(3) **Walkways:** There is an implied invitation for the public and police to use a walkway or driveway of a home at a reasonable hour provided not gated or closed off.

(4) **Ruse vis-à-vis Trespass:** Consent by ruse is usually preferred over trespass to gain entry to semi-public property or events. Ruse is part of the trick bag of a private detective, used to gain entrance to places he would not otherwise be invited; whereas, an LEO must use such actions only consistent with department rules and no doubt, a ruse or trespass to gain entry is discouraged by most every police department.

(5) **Entrapment/Roping:** It is entrapment for a police officer to manufacture a crime for the sole purpose of prosecuting it; and if evidence of the infraction is procured by video or observation, the view will be excluded from use in court. A private investigator (PI) also must avoid overt actions which prompt a target to take action he otherwise would not take. The practice of enticing a subject to take such action is referred to as "roping." Evidence may be excluded as evidence if a PI overtly entices his subject to take action he might not otherwise take. The usual distinction is overt action. For instance, a PI cannot knock over a mailbox or smear soap on a front window to entice a supposedly disabled claimant to come out and reinstall or clean. Likewise, he can't shout "fire" in a theater to catch the claimant tossing his cane aside as he runs for the door. On the other hand, he might "suggest" to a third person such as a neighbor that a diamond ring was lost on the subject's front lawn anticipating that the subject, an insurance claimant, will go on hands and knees to find it when the coast is clear.

(6) **Rules of Safe Surveillance** (borrowed with permission *Navigating the Legal Minefields of Private Investigations,* Ron Hankin, Looseleaf Law Publications, Inc., 2008):

Rule 1: ***Stick to the Public Eye:*** what the subject does in the public eye is not protected; that is, in general, the LEO and PI can observe, look and listen, from a place he has a right to be. The public eye means the action can be observed by other members of the public.

Rule 2: ***Don't trespass Private Places:*** that is, don't trespass into the subject's dwelling, curtilage, or space that he reasonably expects is private.

Rule 3: ***Don't scope a Private Place:*** that is, don't use binoculars or hi-powered zoom lens (generally in excess of three-power) to view the interior of a home or other place in which a reasonable expectation of privacy can be claimed. Such a view is not a public view.

Rule 4: ***Don't use the Bad Ruse:*** that is, don't use pretext to gain entry into the subject's dwelling, curtilage, other space he reasonably expects is private, or where custom, usage, and common sense indicate one should steer clear (e.g., abortion clinics, government installations, etc.).

Rule *5*: *Don't use audio on a camera unless okayed by your state laws:* In general, when operating without a warrant, in many jurisdictions, it is a violation of wiretap and eavesdropping laws to take audio of an individual without their consent. If in doubt, turn off the audio on your camera if it will pick up more than your own voice. In some states, even if the subject did not expect his conversation to be private, it is a violation of the state's eavesdropping laws to record his voice.

Admissibility of Photographs/Video into Evidence

Photographic images are generally admissible into evidence if the subject or scene depicted would have been admissible if the judge or jury had personally viewed them at the time they were taken. Whenever a photographic image adds to an understanding of the case, it is admissible, providing the trial judge deems it relevant and a fair representation of the subject it portrays. Of course, however, the trial judge is not the final arbiter. Appellate courts can review decisions of admissibility.

Generally, a proffer of the image for admission as evidence requires the photographer testify the image presented accurately portrays the person or scene as he viewed it. Other factors which the court will consider:

1. The photographic image provides sufficient subject identification that those involved in the activity are recognizable.
2. Evidence of date and time. It has been suggested that with the advent of cell phone cameras, the cell-camera be used to record the image with date and time. This will support the date and time stamp feature of the camcorder, if any.
3. Testimony, usually of the camera operator, that his equipment was in proper working order at the time the photography occurred; or that he had no reason to believe to the contrary.
4. If needed, or questioned, expert testimony that the photographic evidence is free of alterations.
5. Courts may require production of the original unedited photo or video if a copy is proffered.
6. Standard chain of custody testimony to document custodial care during the interim from picture taking to proffer.

Footnotes:

1. *Katz* expected privacy in a street phone booth while in full view of the public and governments agents; thus, overhearing what he had to say was private.
2. The private investigator and security officer must be mindful, however, that a tort

action for invasion of privacy exists when their conduct constitutes an "an intrusion outrageous to the reasonable person." This element of the tort closely mirrors *Katz's* "reasonable expectation of privacy." Thus, the PI and private security officer should not be surprised that when his conduct intrudes into a reasonable person's privacy in an outrageous manner, the standard may be found interchangeable by some judges with a "reasonable expectation of privacy."

3. There are statutes that specifically prohibit picture taking in a public locker room, washroom, or tanning salon regardless of whether there was an expectation of privacy, reasonable or otherwise.

SPEECHREADING FOR EVIDENCE AND INTELLIGENCE ACQUISITION

Introduction

> Speechreading, although an imprecise art, is a tool offering potentials that those in the law enforcement and intelligence communities cannot legitimately ignore.

This treatise, prepared with the assistance of Neil Bauman, Ph.D.,[2] Director of the Center for Hearing Loss Help, provides an overview of this important topic as it pertains to the acquisition of evidence and intelligence.

In many instances, surreptitiously obtaining audio recordings of a subject's verbal conversations is impossible. In other instances, law forbids the nonconsensual audio recording of a subject's verbal conversations without a warrant issued by a court of competent jurisdiction. In the United States, laws addressing this issue vary by state and penalties for violations are severe. In some states, recording a verbal conversation without a warrant is legal so long as one party to the conversation is aware of the recording and has consented to it. In other states, recording a verbal conversation without a warrant is legal only when all participants are aware of the recording and have consented to it. Laws also vary by country.

When considering practical and legal constraints while at the same time recognizing the long-range capability of modern optics, a compelling ques-

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tion presents itself. Why not record high-resolution moving video images of a subject and then have skilled speechreaders study the video to decipher the subject's words?

Speechreading

> The characteristic face, lip, and tongue movements that accompany each speech sound makes speechreading possible. Observing body language and considering the context within which the speaker's conversation occurs enhances accuracy.

For the most part, the term speechreading has replaced the term lipreading, although the term lipreading remains in use. The term speechreading seems more appropriate because while lipreading suggests reading speech by observing movements of the lips and mouth, speechreading involves much more. Speechreaders observe movements of the lips and mouth and they observe facial expressions and body language. The City Lit Center for Deaf People (n.d., n.p., *Lipreading*) located in London, England, explains that, "Lipreading [Speechreading][3] is 'seeing the sound of speech'–the movements of the lips and the tongue, together with facial expression and body language are all clues for the Lipreader. The Lipreader will also observe the syllables, the natural flow, the rhythm and phrasing and the stress of speech."

Speechreading is an art that is neither easy nor accurate, but some people excel at it. Speechreaders commonly realize an accuracy rate of about 25 to 35 percent with some exceptional speechreaders demonstrating much greater accuracy. As Neil Bauman explains, "The 25 to 35 percent accuracy rate is for a typical speechreader. The truly outstanding ones have an accuracy rate much higher. For example, expert UK speechreader, Jessica Rees has an accuracy rate in the 90s under appropriate conditions. I have known some other incredible speechreaders who have very high accuracy rates. They are just not the norm" (Neil Bauman, personal communication, October 29, 2009).

Although some speechreaders demonstrate greater accuracy than others do, the ability of the speechreader is only half the equation. The manner in which people speak determines how accurately somebody can speechread what they say. As Neil Bauman explains, "Accuracy is related to how easy any given person is to speechread. I can speechread everything some people

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3. "In the UK, they use the term lipreading to mean what we in the United States call speechreading. Over here, we use these two terms differently. To us, lipreading is just the mouth–speechreading observes the whole body–anything that helps us figure out what the person is saying" (Neil Bauman, personal communication, October 29, 2009).

say and others I cannot even speechread one syllable" (Neil Bauman, personal communication, October 29, 2009).

The characteristic face, lip, and tongue movements that accompany each speech sound makes speechreading possible. Observing body language and considering the context within which the speaker's conversation occurs enhances accuracy. Nevertheless, speechreading is not easy or completely accurate. As explained by the City Lit Center for Deaf People (n.d., n.p.), "Not all words are easy to Lipread, and some people talk very fast, or mumble, or cover their mouths when they speak. . . ."

Speechreaders cannot identify every word a person says because certain phonemes feature the same face, lip, and tongue movements. Consider for example that a person saying the letters "b" and "p" exhibit the same face, lip, and tongue actions. Thus, the words "bat" and "pat" look identical to a speechreader. Furthermore, some phonemes defy visual identification because the speaker produces the sound in the back of the mouth and throat such as "g" and "ng" sounds. Still other letters are totally invisible. For example, the letter "h" cannot be seen–it is always invisible. As a result, the words "hear" and "ear" look identical to a speechreader. The speechreader must determine which word the speaker used by its context in the sentence.

Speechreaders identify sounds and words based on what they see and different languages feature different sounds and methods for their production. Therefore, understanding why some languages are easier to speechread than others are is not difficult. On this issue, Neil Bauman (2000, March, n.p.) explains that, "English is not a particularly easy language to speechread. Some languages are much easier (and some are even harder)."

Relative to the English language, the question begging an answer is, what percentage of spoken sounds and words can speechreaders identify? Neil Bauman (2000, March, n.p.) explains that, "The best estimates are that 30% to 35% of English sounds can be speechread. In order for a sound to be easily speechread, it must be formed on the lips and/or in the front of the mouth."

Unfortunately, speechreaders tend to miss much of what a person says even though the words may be identifiable. Neil Bauman (2000, March, n.p.) explains that:

> During normal speech, we make approximately 13 to 15 speech movements per second. However, our eyes can only pick up 8 or 9 of these movements. Thus, it is impossible to speechread perfectly. If a person is talking at a normal rate, we will miss between one quarter and one-half of what they say just because our brains cannot keep up–our eyes/brains cannot work fast enough to identify them.

Speechreaders studying high quality moving video images enjoy an advantage because they can view the images repeatedly. Moreover, having the ability to slow the stream of images maximizes reconstruction capability. Being able to repeatedly play the video, and slow it, enhances interpretation accuracy and the amount of information acquired. As Neil Bauman explains:

> When studying a video you can slow it down to see more of those missing lip movements and your accuracy can go up. I find that slowing down a typical video about 50% really helps when I am not sure what the person is saying. (Neil Bauman, personal communication, October 29, 2009)

Before proceeding to discussion of speechreading for evidence and intelligence acquisition, an emerging technology begs acknowledgement. Evidence suggests that appropriately programmed computers can speechread more accurately than humans can. Although computerized speechreading is a developing technology at the time of this writing, those in the investigative and intelligence fields should monitor its development. Likely, and hopefully, the near future will see the development of practical speechreading software. At the time of this writing, research is underway at the University of East Anglia (UEA) in the UK to develop a computerized speech-recognition system that will convert lip and mouth movements into written text. The ambition is to perfect the technology and extend it to languages besides only English (Gingichashvili, 2008, January 16, n.p.).

Speechreading for Evidence and Intelligence Acquisition

> When circumstances permit and the importance of a case justifies it, assign two or more surveillance specialists to photograph subjects from multiple locations. From different directions, the specialists record close-up moving video images of the subject's faces as they verbally converse. Comprehensive videography coverage enables speechreaders to examine the video images and reconstruct a good portion of the subject's conversation.

After legally recording moving video images of subjects engaged in verbal conversation, and when the importance of the case justifies it, consider having skilled speechreaders scrutinize the video images. With a suitable quality video to study, skilled speechreaders can reconstruct much of a conversation and their findings may reveal essential information.

From a long distance, modern high-magnification optics can record adequate detail for speechreader use. At the time of this writing, some digital single-lens reflex (DSLR) cameras record high-definition moving video images,

which increase image quality and working distances. That technology is developing and will continue to develop.

Speechreaders need a quality video to study. Hence, place emphasis on image quality when recording the subject–record high-definition video at no less than 30 frames per second (fps). Neil Bauman's advice is to "always record speechreading videos at 30 frames per second (or faster). If you record the video at a slower rate, you will lose some critical mouth movements a speechreader needs for accurate speechreading" (Neil Bauman, personal communication, October 31, 2009). Recording a subject under low-light conditions usually results in images unsuited for speechreading interpretation.

Other sections of this book emphasize using adequate magnification but no more during photographic surveillance. Magnification must be sufficient to record important detail such as subject identification (i.e., facial recognition) and legible vehicle number plates (license plates), but no additional magnification is necessary or desired. Too much magnification is undesirable because, among other reasons, the images must include enough of the subject area to document context and the location of activity. Unfortunately, photographing to these criteria leaves a video useless for subsequent speechreading interpretation of subject conversations. To be useful for speechreading interpretation, image size of the subject's face must be adequate. As Neil Bauman explains:

> You need the head to fill at least half the frame (or more) for reliable results. Typically, a good distance for accurate speechreading is 3 to 6 feet [0.914 to 1.828 meters] when in person. So having a video that approximates that would be a good target to aim for. Often the videos people ask me to decipher are blurry, jerky, not properly exposed, not frontal headshots and the heads are too small. As a result, often I cannot help the person. The better the video, the better the chance someone can speechread it. (Neil Bauman, personal communication, October 29, 2009)

When anticipating that speechreading interpretation of moving video images will be necessary, the surveillance operation features an additional dimension. That is, while one or two surveillance specialists record subject activity in the usual manner additional specialists use greater focal length lenses to record close-up moving video images of the faces of the subjects. As Neil Bauman explains, "When recording two or more people talking, a separate photographer records a close-up view of the face of each person, concentrating only on that person. Record each person for the entire duration of the conversation, even while not speaking. When the subject's are facing each other, the photographers will need to be positioned opposite each other

in order to get full frontal head shots" (Neil Bauman, personal communication, October 31, 2009).

The following list emphasizes things to consider when the need exists to extract verbal conversation from a video. The list includes issues to consider when selecting speechreaders for the task. Rarely will individual speechreaders possess all the qualities listed; select people with as many of the attributes as possible. There is merit to assigning several speechreaders with varied competencies because the strengths of each compensate for the weaknesses of others.

- Speechreader should be familiar with the subject's culture and/or subculture.
- Speechreader must be fluent in the subject's language.
- Speechreader must be fluent in the subject's dialect.
- Speechreader should be familiar with terms, phrases, and slang (jargon; vernacular; colloquial speech) unique to the subject's region and culture.
- Speechreader should be familiar with terms, phrases, and slang unique to the subject's age group and gender.
- Consider assigning speechreaders in the same age range as the subjects to study the video images.
- Speechreader should have an education and occupational background comparable to that of the subject.
- Speechreader should know as much as possible about the subject's licit and illicit activities–situational information can provide the context necessary to identify more words. As Neil Bauman explains (2000, March, n.p.), "In order for speechreading to be effective we have to know the subject being discussed. . . . This only works when we know the context."
- Speechreaders with the ability to interpret body language enjoy an advantage.
- Assign both male and female speechreaders to study the video images. In some instances male speechreaders enjoy an advantage because of masculine context, but as Neil Bauman (2000, March, n.p.) explains, "Women on the average are much better speechreaders than men."
- Speechreaders should be familiar with current events.
- Each speechreader transcribes their interpretations.
- Be aware that each individual speechreader may identify words that other speechreaders failed to identify.
- After each speechreader has scrutinized the video separately and transcribed their interpretations, have them assemble as a group and view

the video together. This can have a synergistic effect. They can discuss what each other sees and put all their differing points of view together and perhaps prepare a much better transcript than any of them could do alone (Neil Bauman, personal communication, October 29, 2009).

- When a transcription exists for more than one party to a conversation, the identifiable words of one party can help to identify unknown words of the other.

Contemplate all the preceding information relative to what Neil Bauman says about speechreading. He explains that "a perfect speechreader only would be able to speechread about one-third of what is said. They guess at the rest, taking into consideration their understanding of the spoken language, the body language of the speaker and the subject under discussion. Some people are remarkably good at guessing but no one is perfect" (Bauman, 2000, March, n.p.).

If speechreaders can identify one-third of a subject's conversation, the result is the acquisition of a great deal of information that otherwise would be absent. Among the identified portions of the conversation may be a vital piece of information that the investigator or intelligence officer desperately needs.

Summary

Use the art of speechreading to advantage but recognize its limitations and avoid placing excessive reliance on it. How the art is used enhances or diminishes its perceived credibility.

Speechreading is an imprecise art, not an exact science. Speechreader skill levels vary and some people are easier to speechread than others are, and the circumstances of speech vary. As for the interpretation of what video recorded subjects are saying, image quality must be adequate for a reliable interpretation to occur. When presented with an inadequate video the speechreader should not attempt interpretation.

Although speechreading is an imprecise art, that is not a valid reason to discount it as an investigative or intelligence collection tool. Nevertheless, impreciseness of the art demands that speechreaders err on the side of caution and that the authorities refrain from using speechreading interpretation to the exclusion of other evidence. A speechreader should present with confidence the words he or she interpreted with confidence, and admit uncertainty when it exists. When in doubt, present the interpretation as such. Speechreading evidence, like many types of evidence, serves best when viewed within the context of corroborating evidence.

Computerized speech-recognition is an emerging technology that likely will advance to the point that it can convert lip and mouth motions into written text. "When using computerized speechreading in the future, the computers' needs will likely be similar to those of human speechreaders–namely the better the quality of the video and the bigger the facial images, the greater the accuracy of the resulting transcription" (Neil Bauman, personal communication, November 3, 2009). As computerized speech-recognition technology evolves, will it reach a point that eliminates the need for human speechreaders? Alternatively, perhaps computerized speechreading and human speechreading will function in a mutually supporting manner. Perhaps, on a case-by-case basis each will to varying degrees validate the other and suggest when interpretation uncertainty exists.

An advantage that a computerized speech-recognition system will have is the ability to see all the 13 to 15 speech movements per second that occur when a person speaks. Human speech readers cannot do that. As Neil Bauman explained earlier, "During normal speech, we make approximately 13 to 15 speech movements per second. However, our eyes can only pick up 8 or 9 of these movements . . . because our brains cannot keep up–our eyes/brains cannot work fast enough to identify them" (Bauman, 2000, March, n.p.). A computerized speech-recognition system will have the ability to identify all speech movements. Human speech readers can augment the computer-based interpretations by considering the human factor (e.g., observing body language and considering the context within which the speaker's conversation occurs).

HIRING A CLANDESTINE PHOTOGRAPHY CONSULTANT

When Is a Clandestine Photography Specialist Necessary?

> A good clandestine photography specialist is imaginative and capable of case-specific problem solving. He or she believes that where there is a will there is a way, always seeking the best way. They operate outside the box, figuratively speaking, never accepting mediocrity or failure of imagination. If doing something is possible, they will determine how to accomplish it.

An epigraph at the beginning of Chapter 4 states that, "Surveillance activities may involve highly specialized techniques and equipment that require technical training and knowledge and are best accomplished by trained specialists" (*Forensic Science Communications, Vol. 4,* No. 2, 2002, April, n.p., *Surveillance Photography SOP*). A second epigraph states that, "Surveil-

lance photography is an advanced technique used for obtaining information about an individual or an installation under a full range of threat, weather, and terrain conditions" (FM 31-20-5, 1993, March 23, pp. C-10 – C-11, *Special Reconnaissance Tactics, Techniques, and Procedures for Special Forces*).

In most instances, law enforcement officers, intelligence collection agents, and the members of military special operations forces are not photographers per se. That is, they chose a career other than photography, but they do use photography as a tool with many being skilled with a camera under field conditions. There are times, however, when they benefit from the services of a clandestine photography specialist. A specialist can assist in the following four ways:

- Do the photographic surveillance.
- Assist with the photographic surveillance (i.e., work with the person behind the camera).
- After analysis of case specific photographic needs, determine what equipment is necessary, determine the most appropriate photographic methods, and then indoctrinate appropriate personnel accordingly.
- For situations requiring hybrid photography methods, the clandestine photography specialist does an analysis and then configures photo-optical systems that are specific to the needs of the particular surveillance.
  - Regardless of whether the optical system includes a night vision device, the optical configuration may feature a consumer-, prosumer-, or professional-grade camcorder. Likewise, the system may feature a digital single-lens reflex (DSLR) camera for use in single image mode or in high-definition video capture mode. Circumstances may require two or more optical systems operating simultaneously.
  - Relative to photography using an image intensifier night vision device, the clandestine photography specialist can configure a system featuring the necessary magnification or f-ratio relative to camera-to-subject distance and ambient nighttime illumination.[4] Circumstances determine who will subsequently operate the equipment.

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4. Example: Camera-to-subject distance requires a focal length of approximately 1200mm (+-100mm) and maximizing lens speed (f-ratio) is necessary. The Canon and Nikon 600mm f4 super telephoto lenses used with a 2x tele-converter would provide the required focal length (1200mm) but at f/8, they would be too slow for the level of illumination. Alternatively, the specialist suggests using one of two telescopes by means of afocal coupling. The first suggested electro-optical config-

A clandestine photography specialist can assist in a number of ways, as stated. When called upon to assist, the specialist understands that the needs of field personnel are diverse and often include but are not limited to the following:

- Field personnel often need a long-range or ultra-long-range daytime and nighttime photography capability because no suitable vantage point exists near the subject.
- Safety needs often require a long standoff capability. Additionally, undercover personnel must maintain anonymity.
- Clandestine or covert requirements often make a long standoff capability essential. Under no circumstances must the subject become aware of the investigation or intelligence gathering effort.
- Frequently, field personnel do surveillance after dark and therefore they require a low-light photography capability, both high ISO available light photography and night vision photography.

In many instances, especially for an extended surveillance operation requiring night vision photography, the specialist asks the following questions. For daytime clandestine photography needs, the specialist asks similar questions.

- What night-vision photography system or systems are currently in use?

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uration requires using the 2500mm f/10 Meade 10″ LX90-SC telescope with a50mm eyepiece. Placing a 50mm eyepiece on the telescope and photographing with the ITT NEPVS-14 night vision monocular via afocal coupling results in a system featuring an effective focal length and f-ratio of 1250mm f/5. *The second suggested configuration* requires using the Celestron 2800mm f/10 C11 Schmidt-Cassegrain telescope with a 56mm eyepiece. Afocal coupling using the NEPVS-14 NVD with a 56mm eyepiece on the telescope results in an effective focal length and f-ratio of 1250mm f/4.55. The difference between f/8 and f/5 is 1 1/3 stops (specifically 1.3561 stops). The difference between f/8 and f/4.55 is 1 2/3 stops (specifically 1.6283 stops). For night vision photography, a gain of 1 1/3 stops is significant with a 1 2/3 stops gain being even better. For a static (stationary) photographic surveillance that likely will occur over a period of 1–3 years, the surveillance photography specialist may configure both systems to determine which performs best under the circumstances. The best performing system remains on site. If an even faster optical system is required, the specialist makes the following recommendation. Use the 3910mm f/11 14′ Celestron C14 Schmidt-Cassegrain telescope with an f/6.3 focal-reducer and a 56mm telescope eyepiece and photograph using the ITT NEPVS-14 night vision monocular via afocal coupling. That optical configuration provides an effective focal length and f-ratio of 1100mm f/3.1 (specifically 1099.617mm f/3.09). The difference between f/8 and f/3.1 is 2 2/3 stops (specifically 2.7355 stops). *Note:* Many surveillance specialists, although lacking the knowledge to configure a case-specific custom electro-optical system are fully qualified to use such a system once a clandestine photography specialist configures it and provides indoctrination regarding its use.

- What is the current night vision photography camera-to-subject capability of the unit for recording detail such as subject identification (i.e., facial recognition) and legible vehicle number plates?
- What is your typical observer-to-subject distance?
- Relative to typical observer-to-subject distance, is that your distance of choice or are you working from that distance because you lack the means to do photography from a greater distance?
- Relative to night vision photography, from what distance do you need to record detail such as subject identification and legible vehicle number plates?
- Do you usually record still photographs or moving video images, or both?
- If you record both still images and video, which predominates?
- Which is most important to you, detailed still images or video showing subject activity?
- What is the typical source of nighttime illumination of the subject area?
- How mobile do you need to be? Stated another way, do you need the means to leave a vantage point quickly if a situation becomes threatening?
- Would the need for mobility be less urgent if you could photograph from greater distances?

Once receiving answers to the above questions, accompanied by the person in charge of the surveillance operation, the specialist does a site survey. Once determining such things as camera-to-subject distance, elevation of the vantage point, and nighttime illumination level, the specialist determines equipment needs and the most suitable photography methods to use.

When photographing will occur in a high-threat and active countersurveillance environment, much of the preliminary work may occur elsewhere. For example, using the urban environment for illustration purposes, the specialist may do the following:

- Locate a suitable vantage point. Having done that, the specialist knows the camera-to-subject distance, camera elevation, and compass-bearing direction to the subject location.
- Use a light meter (lux meter) to measure the level of nighttime artificial illumination at the subject location.
- Find a secondary location featuring essentially the same circumstances (i.e., camera elevation, camera-to-subject distance, and illumination

level). If necessary, create the circumstances at a remote location. That may require using an industrial scissor lift and generator-powered auxiliary lighting units.

- From the secondary vantage point, the specialist begins configuring an image intensifier night-vision photography system optimized for that circumstance. When doing this the specialist addresses the following issues:
  - Magnification of the optical system must be suitable for the camera-to-subject distance. Determine the minimum magnification necessary to record essential detail. Increasing magnification beyond that point unnecessarily reduces effective f-ratio (aperture) and diminishes field-of-view.
  - Area of coverage is important and determined by camera-to-subject distance and the angle-of-view of the optical system. Lens magnification and the size of the camera or camcorder image sensor determines angle-of-view. The angle-of-view determines the field-of-view at different distances.
  - Required speed (effective f-ratio) of the optical system. In other words, how fast does the optical system need to be?
  - To what extent is size and weight of the optical system important? Can large and heavy equipment be set up for extended use or must surveillance specialists have mobility, the means to easily relocate the apparatus or leave the area quickly if necessary?
  - If somebody else will use the optical system following an indoctrination period, what is the person's level of photographic knowledge and technical expertise? Will they be capable of operating an advanced system after a brief period of indoctrination?

OWNING VERSUS RENTING EQUIPMENT

Whether to own or rent equipment is an important decision. The photography team must own most equipment, but renting some equipment is sensible. Renting is prudent when the equipment is expensive, infrequently needed, and when advancing technology will render it obsolete in a short time. When determining whether to own or rent, things to consider include, but are not limited to, the following:

- Rental availability.
- Rental cost.
- Purchase price.

- Frequency of need.
- Useful life of the product before advancing technology renders it obsolete.
- Condition and reliability of rental equipment. Many people abuse rental equipment rather than respecting it and treating it as it is were their own, which affects equipment reliability.
- Professionalism and reliability of the business providing rental equipment. Not all businesses care about customer service and therefore not all businesses check the condition of rental equipment before providing it to a customer.
- When renting equipment in person, verify its good working order before leaving the premises with the product. When renting equipment from a distant company that will ship the product, consider renting early so that time exists to obtain a replacement should a product arrive defective. Another option is to rent an extra unit–if the case requires two units, rent three. The feasibility of renting an extra unit depends on how essential the equipment is to the case, the time-sensitive nature of the case, the importance of the case, the nature of the equipment, and rental cost.
- In some instances, owning a product is the best choice with a rental product occasionally obtained for the following reasons:
  - Accommodate overload work.
  - Replace the owned product while it is out for service or repair.
  - Serve as a backup so that failure of the owned product cannot disrupt a critical mission.

Owning some equipment is necessary because nobody rents such products. For example, at the time of this writing, nobody rents the Canon and Nikon 600mm f/4 super telephoto lenses, and neither is the Canon 800mm f/5.6 super telephoto lens available for rent. While some night-vision devices are available as rental items, availability is limited and the supplier may not have the desired configuration.

CUSTOM FABRICATION OF SPECIALTY PRODUCTS

Plato (427?-347), the Greek philosopher said that necessity is the mother of invention. Somebody else postulated that creativity is the father of invention and knowledge is the midwife. Certainly, prerequisite to progress is need, intelligence, creativeness, and ambition.

In previous chapters, the reader encountered products that the authors invented and fabricated to meet specific needs. Inventing and fabricating specialized products is necessary because some products essential for manual clandestine photography are unavailable on the commercial market. Astronomers face a similar situation and that is why many observatories and devoted amateur astronomers have a machine shop, or they contract with a machine shop to make specialized one-off products.

A small machine shop enables the surveillance specialist to manufacture almost anything needed to meet specialized needs. When equipping a small machine shop consider the following items.

- Metal lathe
- Milling machine
- Drill press
- Band saw/metal
- Bench grinder
- Bench buffer/polisher
- Portable angle grinder
- Belt/disc sander
- Welder
- Hydraulic press
- Assorted hand tools

Those who decide to fabricate specialty apparatus for manual clandestine photography need to be aware of ScopeStuff® Telescope Accessories and Hardware (www.scopestuff.com), and CameraFilters.com™ (www.camera filters.com).

REFERENCES

About ITT night vision. (2009). ITT Night Vision & Imaging. Retrieved June 11, 2010, from http://www.nightvision.com/products/law_enforcement/case-study_security_events.htm.

About optical filters. (2011). GlobalSpec. Retrieved January 28, 2011, from http://www.globalspec.com/LearnMore/Optical_Components_Optics/Optical_Components/Optical_Filters.

About organized crime. (2008). Federal Bureau of Investigation. Retrieved February 25, 2008, from http://www.fbi.gov/hq/cid/orgcrime/aboutocs.htm.

A closer look at refractors: Achromatic refractors. (n.d.). Telescopes and Astronomy. Retrieved February 17, 2008, from http://www.telescopes-astronomy.com.au/telescopes013.htm.

Advanced movie recording for myriad applications. (2010). Canon U.S.A. Retrieved August 30, 2010, from http://www.usa.canon.com/cusa/consumer/products/cameras/slr_cameras/eos_1d_mark_iv#Features.

Aerial photography sop. (2002, April). *Forensic Science Communications, Vol. 4,* No. 2, 2002, April). Retrieved February 23, 2011, from http://www2.fbi.gov/hq/lab/fsc/backissu/april2002/swgitfield1.htm#guidelinesforsurveillancephoto.

Aeromedical training for flight personnel. FM 3-04.301, FM 1-301. (2000, September 29). Washington, DC: Department of the Army.

Airplane flying handbook: Night vision. (2005, August 16). Federal Aviation Administration, U.S. Department of Transportation. Retrieved June 16, 2010, from http://www.faa.gov/library/manuals/aircraft/airplane_handbook/.

Air pollution. *The Columbia encyclopedia* (6th ed.). New York: Columbia University Press, 2001–07. www.bartleby.com/65/. Retireved November 17, 2007, from http://www.bartleby.com/65/ai/airpollu.html.

A look back . . . John Ford: War movies, filming for the OSS. (2009, January 9). Central Intelligence Agency. Retrieved January 14, 2009, from https://www.cia.gov/news-information/featured-story-archive/john-ford.html.

A military guide to terrorism in the twenty-first century. (2007, August 15). U.S. Army TRADOC G2 Handbook No. 1 (Version 5.0). Fort Leavenworth, Kansas. Retrieved April 4, 2008, from http://www.fas.org/irp/threat/terrorism/guide.pdf.

Anti-human Rhodopsin purified. (2009). Leinco Technologies, Inc. Retrieved June 16, 2010, from http://www.leinco.com/product?R127.

Archer, K. (2006). *Frequently asked questions: How far can I see with a telescope?* Ken Archer's Ironwood Observatory. Retrieved January 6, 2008, from http://www.ironwoodobservatory.com/support.htm.

Assessing and counseling older drivers. (2010, February 3). Physician's Guide to Assessing and Counseling Older Drivers (2nd ed.). American Medical Association. Retrieved November 28, 2010, from http://www.nhtsa.gov/search/?q=car+color+and+safety&site=nhthqnlas187_Pages&client=default_frontend&output=xml_no_dtd&ie=UTF-8&ip=204.68.195.112&access=p&sort=date%3AD%3AL%3Ad1&entqr=0&start=10.

Astronomy & atmosphere: The effects of weather and the atmosphere. (1998, February 12). Deepsky Observers Companion. Retrieved January 6, 2008, from http://www.fortunecity.com/roswell/borley/49/atmosph.htm.

Astronomy 161, The solar system. The earth's atmosphere: Troposphere. (n.d.). University of Tennessee, Department of Physics & Astronomy. Retrieved January 19, 2008, from http://csep10.phys.utk.edu/astr161/lect/index.html.

AstroScope for Canon [and Nikon] SLR cameras. (2011). Sofradir EC, Inc. Retrieved January 20, 2011, from http://www.nightvisioncameras.com/nv-intensifiers.html.

Astrozap Dual Channel Controller. (2006). Astrozap–Oakland Group, Inc. Retrieved October 9, 2009, from http://www.astrozap.com/pages/dew-controller.htm.

ATF's history. (n.d.). Bureau of Alcohol, Tobacco, Firearms, and Explosives. Retrieved December 15, 2010, from http://www.atf.gov/about/history/.

Atkins, B. (2010, October 16). *Mirror lock-up [MLU].* Bob Atkins Photography, BobAtkins.com. Retrieved October 16, 2010, from http://www.bobatkins.com/photography/tutorials/mlu.html.

Atmosphere. (1997). *Compton's encyclopedia & fact-index* (Vol. 2). Chicago: Compton's Learning Company.

Atmosphere. (1996). The New Book of Knowledge. Danbury, CT: Grolier Incorporated.

Auto-Gated power supply. (2011). Morovision Night Vision, Inc. Retrieved April 6, 2011, from http://www.morovision.com/terminology.htm.

Baranec, C., Lloyd-Hart, M., & Steward, N. M. (n.d.). *Ground-layer wavefront reconstruction from multiple natural guide stars.* Tucson, AZ: Observatory, University of Arizona. Retrieved January 5, 2008, from http://caao.as.arizona.edu/publications/Baranec_ApJ_NGS_GLAO.pdf.

Barnes III, F. S. (2009). *How I deal with dew.* TwinOaks / Blue Sky Observatories. Retrieved August 31, 2009, from http://www.skyimager.com/Dew-Fix.html.

Barrett, D. (2009, December 17). *Gangs more deadly than some Gitmo detainees.* Associated Press. Retrieved December 18, 2009, from http://news.yahoo.com/s/ap/20091217/ap_on_go_ot/us_terror_trials_judge.

Battle of Suomussalmi. (2010, March 11). *Wikimedia Foundation, Inc.* Retrieved March 15, 2010, from http://en.wikipedia.org/wiki/Battle_of_Suomussalmi.

Bauer, J. (2002). *The blood of patriots: A critical analysis of the anti-government militia movement in 21st century America.* James Madison University. Retrieved June 29, 2010, from http://74.6.239.67/search/cache?ei=UTF-8&p=white+supremacist+and+anti-government+militia+groups&xa=h3b.cjmT2MXMXQNPlpGXjw–%2C1277955065&fr=yfp-t-701&u=www.jmu.edu/writeon/documents/2002/bauer.pdf&w=white+supremacist+anti+government+militia+groups&d=E8yAKLZfU9Sc&icp=1&.intl=us&sig=9Rdmka60XZwunuCB7hkyGQ–.

Bauman, N. (2000, March). *Speechreading (lip-reading).* Center for Hearing Loss Help. Retrieved October 28, 2009, from http://www.hearinglosshelp.com/articles/speechreading.htm.

Being seen can mean being hit. (2006). camouflage.com (Tenebraex Corporation). Retrieved August 25, 2009, from http://www.camouflage.com/ards.php.

Blooming. (2011). Morovision Night Vision, Inc. Retrieved March 29, 2011, from http://www.morovision.com/terminology.htm.

Body language. (n.d.). *The American Heritage dictionary of the English language, Fourth Edition.* Retrieved February 19, 2010, from Dictionary.com website: http://dictionary.reference.com/browse/body language.

Bofrone, K. E. (1993, September 22). Intelligence photography. Central Intelligence Agency. Retrieved November 16, 2008, from https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/vol5no2/html/v05i2a02p_0001.htm.

Bromberg, I. (2007, September 16). *The duration of twilight.* Retrieved April 11, 2008, from http://individual.utoronto.ca/kalendis/twilight/index.htm.

Camouflage, concealment, and decoys. (1999, August 30). Field Manual No. 20-3. Washington, DC: Department of the Army.

Car color and safety white paper. (2004, July 20). AAA Foundation for Traffic Safety. Retrieved November 28, 2010, from http://74.6.238.254/search/srpcache?ei=UTF-8&p=accident+rate+by+vehicle+color&fr=yfp-t-701&u=http://cc.bingj.com/cache.aspx?q=accident+rate+by+vehicle+color&d=4747090058611233&mkt=en-US&setlang=en-US&w=fb53f3a6,8af967b3&icp=1&.intl=us&sig=6aVPEHY.W9EfJuSI5_fgvg–.

Carl Zeiss announces the Victory PhotoScope 85 T FL: Simultaneous observation and photography with one compact unit.* (2009, September 29). Carl Zeiss Optical, Inc. Retrieved June 3, 2010, from http://www.zeiss.com/c1256bcf0020be5f/Contents-Frame/26877919fba3dfe7852576400070a8fc.

Carter, S. A., (2007, November 26, n.p.). Terrorists target Army base–in Arizona. *The Washington Times, LLC.* Retrieved February 24, 2008, from http://www.washingtontimes.com/apps/pbcs.dll/article?AID=/20071126/NATION/111260034/1001.

Catadioptric system. (2010, June 14). *Wikimedia Foundation, Inc.* Retrieved September 23, 2010, from http://en.wikipedia.org/wiki/Catadioptric_system.

Celestron f/6.3 focal reducer. (2010). Skies Unlimited. Retrieved July 11, 2010, from http://www.skiesunlimited.net/index.php?ProductID=235.

CGE PRO 925 HD Computerized Telescope. (2011). Celestron.com. Retrieved February 22, 2011, from http://www.celestron.com/c3/product.php?CatID=93&ProdID=572.

Charles, J. R. (2000). *Practical astrophotography.* London: Springer.

Classified information. (2008, October 17). *DOD dictionary of military and associated terms.* Retrieved March 16, 2009, from http://www.dtic.mil/doctrine/jel/doddict/data/c/index.html.

Coatings. (n.d.). Carl Zeiss Optical, Inc. Retrieved November 16, 2009, from http://www .zeiss.com/c1256bcf0020be5f/Contents-Frame/b2c9c57b595663ca8525756900546606.

"Cold war." *The Columbia encyclopedia* (6th ed.). 2008. Retrieved January 15, 2009 from Encyclopedia.com: http://www.encyclopedia.com/doc/1E1-coldwar.html.

Congressional testimony: Terrorism preparedness. (2002, March 1). FBI.gov. Retrieved July 7, 2010, from http://www.fbi.gov/congress/congress02/thomas030102.htm.

Congressional testimony: The threat of eco-terrorism. (2002, February 12). FBI.gov. Retrieved July 7, 2010, from http://www.fbi.gov/congress/congress02/jarboe021202.htm.

Costa, A. M. (2007, April 25). *An opium market mystery.* The Washington Post Company. Retrieved March 8, 2008, from http://www.washingtonpost.com/wp-dyn/content/article/2007/04/24/AR2007042401508.html.

Counterintelligence. (2010, April). DOD Dictionary of Military and Associated Terms. Retrieved June 13, 2010, from http://www.dtic.mil/doctrine/dod_dictionary/.

Country reports on terrorism. (2007, April 30). U.S. Department of State. Retrieved April 4, 2008, from http://www.state.gov/s/ct/rls/crt/2006/82738.htm.

Covington, M. A. (1999). *Astrophotography for the amateur* (2nd ed.). New York: Cambridge University Press.

Covington, M. A. (2007). *Digital SLR astrophotography.* New York: Cambridge University Press.

Criminal Intelligence Service Canada releases 2007 annual report to raise public awareness about organized crime. (2007, August 17). Criminal Intelligence Service Canada. Retrieved March 29, 2008, from http://www.cisc.gc.ca/media2007/news_release_2007_e.htm.

Cuba. (2008, March 20). The World Factbook. Central Intelligence Agency. Retrieved March 30, 2008, from https://www.cia.gov/library/publications/the-world-factbook/geos/cu.html#Intro.

Curtain, D. P. (2007). *Flash power and range.* Curtin's Guide to Digital Cameras: And Other Photographic Equipment. Retrieved August 10, 2010, from http://www.shortcourses.com/guide/guide2-28.html.

Dead drop. (n.d.). *WordNet® 3.0.* Retrieved April 17, 2010, from Dictionary.com website: http://dictionary.reference.com/browse/dead drop.

Definition of Nyctalopia. (2010). MedicineNet, Inc. Retrieved June 17, 2010, from http://www.medterms.com/script/main/art.asp?articlekey=6448.

Dembowski, B. (n.d.). *Lunar photography.* The American Lunar Society. Retrieved April 5, 2010, from http://www.amlunsoc.org/photography.htm.

Depth perception . . . is grossly overrated! (2010). LostEye. Adkisson Publishing, Inc. Retrieved June 17, 2010, from http://www.losteye.com/depthper.htm.

Dew. (2006). Altalab, Inc. Retrieved June 15, 2010, from http://www.altalabinstrument.com/glossary.html#r.

Dew point (DP). (2006). Altalab, Inc. Retrieved June 15, 2010, from http://www.altalabinstrument.com/glossary.html#r.

Dewpoint warning. (2010, May 12). Ameritherm Inc. Retrieved June 15, 2010, from http://www.ameritherm.com/dewpoint.html.

Digiscoping. (2010). Optics4Birding.com. Retrieved November 3, 2010, from http://www.optics4birding.com/digiscoping.aspx.

Dowling, John, E. (1987). *The retina: An approachable part of the brain.* Cambridge, MA: Belknap Press of Harvard University Press.

Draeger, J. (2007, November 28). *Financial aid hack: The multitasking myth and how to really increase productivity.* National Association of Student Financial Aid Administrators (NASFAA). Retrieved July 23, 2010, from http://www.nasfaa.org/publications/2007/fahmultitask112807.html.

Draganflyer X6 overview: What is the Draganflyer X6? (2010). Draganfly Innovations Inc. Retrieved May 2, 2010, from http://www.draganfly.com/uav-helicopter/draganflyer-x6/.

Dynamic range. (2009). Glossary Digital Cameras. Canon UK. Retrieved March 3, 2009, from http://www.canon.co.uk/For_Home/Product_Finder/Cameras/Digital_Camera/digicam_glossary.asp.

El Rukn. (2008, January 29). MIPT Terrorism Knowledge Base. Retrieved February 24, 2008, from http://www.tkb.org/Group.jsp?groupID=3230.

EOS 5D Mark II firmware upgrade. (2011). Canon U.S.A., Inc. Retrieved January 7, 2011, from http://www.usa.canon.com/cusa/consumer/standard_display/EOS_5DMKII_Firmware.

EOS 5D Mark II: Movie mode basics. (2010). Canon U.S.A., Inc. Retrieved December 24, 2010, from http://www.usa.canon.com/dlc/controller?act=GetArticleAct&articleID=2186.

Eye changes with aging. (2009, May 19).The Eye Digest. Chicago: University of Illinois Eye & Ear Infirmary. Retrieved March 13, 2011, from http://www.agingeye.net/visionbasics/theagingeye.php.

Eyepiece. (n.d.). *The American Heritage science dictionary.* Retrieved August 05, 2009, from Dictionary.com website: http://dictionary.reference.com/browse/eyepiece.

FBI careers in investigative support and surveillance: Surveillance specialist. (n.d.). Federal Bureau of Investigation. Retrieved June 12, 2010, from https://www.fbijobs.gov/127.asp#2.

Field curvature. (2009). Astronomics. Retrieved March 10, 2011, from http://www.astronomics.com/main/definition.asp/catalog_name/Astronomics/category_name/t4b979mee6mq29m2uwf/Page/1.

Fighting transnational organized crime. (2000, March). United Nations Department of Public Information. Retrieved February 25, 2008, from http://www.un.org/events/10thcongress/2088f.htm.

Filmtools Sound Blanket/Furniture Pad–78″ x 72″ Heavy Duty Black. (2010). Filmtools. Retrieved December 4, 2010, from http://www.filmtools.com/filmtools-furniture-pads-black.html.

Fluoroscopy. (2011, February 23). *Wikimedia Foundation, Inc.* Retrieved March 13, 2011, from http://www.experiencefestival.com/a/Fluoroscopy_-_History/id/1397709.

F-number. (2010, June 12). *Wikimedia Foundation, Inc.* Retrieved June 16, 2010, from http://en.wikipedia.org/wiki/Focal_ratio#Human_eye.

Focal ratio. (n.d.). Aquila Optical & Electronics. Retrieved March 10, 2011, from http://www.aoe.com.au/telescope_dictionary.html.

Focal reducers. (2011). Skies Unlimited. Retrieved January 2, 2011, from http://www.skiesunlimited.net/index.php?CategoryID=90.

Fredrickson, D. D., & Siljander, R. P. (2002). *Racial profiling: Eliminating the confusion between racial and criminal profiling and clarifying what constitutes unfair discrimination and persecution.* Springfield, IL: Charles C Thomas.

Fredrickson, D. D., & Siljander, R. P. (2004). *Street drug investigation: A practical guide for plainclothes and uniformed personnel.* Springfield, IL: Charles C Thomas.

Gecker, J. (2004, August 4). *Legendary photographer Henri Cartier-Bresson dies at age 95.* The Associated Press (reprinted by The Seattle Times Company). Retrieved December 16, 2008, from http://community.seattletimes.nwsource.com/archive/?date=20040804&slug=webbresson04.

Gellman, B. (2010, October 1). The secret world of extreme militias. *Time Inc.* Retrieved October 2, 2010, from http://news.yahoo.com/s/time/08599202251600.

Geotagging George. (2009, November 21). *Geotagging cameras—Cameras that geotag photos automatically.* GeotaggingCameras.com. Retrieved October 18, 2010, from http://www.geotaggingcameras.com/.

Gingichashvili, S. (2008, January 16). *Criminals beware: Computerized lip reading.* The Future of Things. Retrieved July 27, 2010, from http://thefutureofthings.com/news/1089/criminals-beware-computerized-lip-reading.html.

Global studies on organized crime. (1999, February). United Nations Interregional Crime and Justice Research Institute. Retrieved February 25, 2008, from www.uncjin.org/CICP/gsoc_e.pdf.

Global trends 2015: A dialogue about the future with nongovernment experts. Transnational Terrorism. (2000, December). National Intelligence Council. Retrieved April 4, 2008, from http://www.dni.gov/nic/NIC_globaltrend2015.html.

Hartley, D. (2005). *Photography—the lens: Primes vs zooms.* Picture Correct. Retrieved July 25, 2009, from http://www.picturecorrect.com/photographytips/photography_camera_lens_types_kinds.htm.

Harwood, M. (2010, April 26). *Study finds rise in lone wolf terrorist attacks since Oklahoma City.* Security Management Online. Retrieved July 1, 2010, from http://www.securitymanagement.com/news/study-finds-rise-lone-wolf-terrorist-attacks-oklahoma-city-007030.

Hass, C. (2008). *Digital camera shutter lag & startup time: Shutter lag—what is it?* Impulse Adventure. Retrieved February 12, 2009, from http://www.impulseadventure.com/photo/shutter-lag.html.

Hellman, C., & Huang, R. (2008, June 16). *Terrorism project: List of known terrorist organizations.* Center for Defense Information. Retrieved June 18, 2008, from http://www.cdi.org/terrorism/terrorist-groups.cfm.

Henri Cartier-Bresson. (2010). BrainyMedia.com. Retrieved February 19, 2010, from http://www.brainyquote.com/quotes/keywords/confines.html.

Hill, Beckers, Brandt, Briggs, Brown, Brown, Collados, Denker, Fletcher, Hegwer, Horst, Komsa, Kuhn, Lecinski, Lin, Oncley, Penn, Radick, Rimmele, Socas-Navarro, & Streander. (2006). *Site testing for the advanced technology solar telescope. Ground-based and Airborne Telescopes, Proc SPIE 6267.* Retrieved January 6, 2008, from http://atst.nso.edu/library/spie/6267-41_Hill.pdf.

Hill, K. F. (2005, October 24). *Introduction to dark adaptation.* Rose Star Products. Retrieved May 4, 2008, from http://home.earthlink.net/~astro-app/horsehead/DarkAdapt.htm.

History of the CIA. (2008, June 2). Central Intelligence Agency. Retrieved January 14, 2009, from https://www.cia.gov/about-cia/history-of-the-cia/index.html.

How heat is transferred. (2007). Prentice-Hall: Science Explorer. Weather and climate. Boston: Pearson Prentice-Hall.

How night vision works. (2008). Morovision Night Vision, Inc. Retrieved September 27, 2008, from http://www.morovision.com/hownightvisionworks.htm.

How often is there a full moon? (2010). Ask.com. Retrieved December 13, 2010, from http://www.ask.com/web?q=How+often+is+the+moon+full%3F&search=&qsrc=0&o=0&l=dir.

How thermal imaging works. (2010). Morovision Night Vision, Inc. Retrieved June 28, 2008, from http://www.morovision.com/how_thermal_imaging_works.htm.

How to use a signal mirror. (n.d.). The Great Cardinal District Boy Scout Leader Roundtable. Retrieved March 27, 2008, from http://www.cardinaldistrict.net/docs/BSRhandout200701.pdf.

How to use long camera lenses. (2010, March 9). Team Bloginity. Retrieved June 23, 2010, from http://www.bloginity.com/arts/photography/how-to-use-long-camera-lenses/14121/.

Human intelligence collector operations. FM 2-22.3. (2006, September 6). Washington, DC: Headquarters, Department of the Army. Retrieved January 24, 2009, from http://www.fas.org/irp/doddir/army/fm2-22-3.pdf.

Image intensification. (2008, September 15). U.S. Army Research, Development and Engineering Command. Night Vision & Electronic Sensors Directorate. Retrieved March 13, 2008, from http://www.nvl.army.mil/technology/index.php.

Image intensifiers. (2010). Sofradir EC, Inc. Retrieved December 13, 2010, from http://nightvisioncameras.com/nv-intensifiers.html.

Image-stabilized binoculars. (2009, July 5). *Wikimedia Foundation, Inc.* Retrieved November 20, 2009, from http://en.wikipedia.org/wiki/Image-stabilized_binoculars.

Innovation in the application of light: Lux, lumen and watts, what's the difference? (2006). Brillianz Ltd. Retrieved February 19, 2010, from http://www.brillianz.co.uk/data/documents/Lumen.pdf.

Intelligence. FM 2-0. (2004, May 17). Washington, DC: Headquarters, Department of the Army.

Iraq's intelligence services: Regime strategic intent–Annex B. (2007, April 23). Central Intelligence Agency. Retrieved March 8, 2008, from https://www.cia.gov/library/reports/general-reports-1/iraq_wmd_2004/chap1_annxB.html.

Iron Curtain. (2010). *Encyclopædia Britannica.* Retrieved August 12, 2010, from Encyclopædia Britannica Online: http://www.britannica.com/EBchecked/topic/294419/Iron-Curtain.

ITT Night Vision case studies. (2010). Morovision Night Vision, Inc. Retrieved March 10, 2010, from http://www.morovision.com/nv_case_studies.htm.

Jan Evangelista Purkyné. (2008, March 21). *Wikimedia Foundation, Inc.* Retrieved May 11, 2008, from http://en.wikipedia.org/wiki/Jan_Evangelista_Purkyn%C4%9B.

Johnson, W. R. (2009). *Thwarting enemies at home and abroad: How to be a counterintelligence officer.* Washington, DC: Georgetown University Press.

JVC HM790U: Indoors and out. (2010). B & H Foto & Electronics Corporation. Retrieved July 11, 2010, from http://video.bhinsights.com/content/jvc-hm790u-indoors-and-out.html.

Kenyon gyrostabilizers instruction manual. (n.d.). Kenyon Laboratories LLC. Retrieved December 20, 2010, from http://www.kenyongyro.net/kenyongyro/id3.html.

Knight, J. (2008). Surveillance cameras in espionage. *Encyclopedia of espionage, intelligence, and security.* Retrieved January 10, 2009, from http://www.espionageinfo.com/Bl-Ch/Cameras.html.

Koehler, K. R. (1996). *Spectral sensitivity of the eye.* Retrieved March 12, 2011, from http://www.rwc.uc.edu/koehler/biophys/6d.html.

Kriff, J. (n.d.). *Jan Evangelista Purkyne.* Physhology Wiki. Retrieved March 1, 2011, from http://psychology.wikia.com/wiki/Jan_Evangelista_Purkyn%C4%9B.

LED application series: Outdoor area lighting. (2008). U.S. Department of Energy. Retrieved November 5, 2010, from http://apps1.eere.energy.gov/buildings/publications/pdfs/alliances/outdoor_area_lighting.pdf.

Lehrer, M. (2010). *Sony HDR-AX2000 first look.* B & H Foto & Electronics Corp. Retrieved June 3, 2010, from http://www.bhphotovideo.com/c/find/newsLetter/Sony-HDR-AX2000.jsp.

Lipreading. (n.d.). City Lit Centre for Deaf People. Retrieved October 28, 2009, from http://www.lipreading.net/lipreading.htm.

Lodriguss, J. (2010). *Telescopes for digital astrophotography.* Retrieved February 28, 2011, from http://www.astropix.com/HTML/I_ASTROP/SCOPES.HTM.

Loh, L. (2008). *Digital SLR Superguide: Why a dSLR?* CNET Networks, Inc., a CBS Company, CBS Interactive Inc. Retrieved August 29, 2008, from http://asia.cnet.com/reviews/digitalcameras/printerfriendly.htm?AT=61988858-39049704t-39000067c-38000061q-1.

Lookout training handbook. NAVEDTRA 12968-D. Center for Surface Combat Systems. (2007, February). Dahlgren, VA: Naval Personnel Development Center.

LX90™, The Best of Both Worlds. (2009). Meade Instruments Corporation. Retrieved July 22, 2010, from http://www.meade.com/lx90/index.html.

MacRobert, A. (2000). *Beating the seeing.* Sky Publishing Corporation. Retrieved January 6, 2008, from http://www2.wwnorton.com/college/astronomy/astro21/sandt/seeing.html.

MacRobert, A. M. (2008). *The art of using a telescope.* Sky Publishing, a New Track Media Company. Retrieved January 6, 2008, from http://www.skyandtelescope.com/equipment/basics/The_Art_of_Using_a_Telescope.html?c=y&showAll=y.

Majewski, S. R. (2007). *ASTR 511 (Majewski) Lecture notes. Observing through earth's atmosphere: Turbulence and seeing.* Charlottesville, VA: University of Virginia. Retrieved January 5, 2008, from http://www.astro.virginia.edu/class/majewski/astr511/lectures/atmos1/turbulence.html.

Manfrotto 4-Section Carbon Fiber Tripod W/Quick Flip Leg Locks. (2010). Bogen Imaging, Inc. Retrieved January 28, 2009, from http://www.bogenimaging.us/Jahia/site/bius/pid/6780?kindOfProductCollectionRequest=productDetail&productCode=055MF4&productDescription=055%20MAG%20FIBER%20TRIPOD%204%20SCT&curBrandId=MAN&market=MKT1.

Mason, M. R. (2010). *A photography portfolio. Challenges of photography #1: Nasty weather–Photography in hot weather.* Retrieved November 11, 2007, from http://www.markraymondmason.com/.

"Matchbox" camera. (2009, January 12). CIA Museum. Retrieved January 14, 2009, from https://www.cia.gov/about-cia/cia-museum/cia-museum-tour/flash-movie-text.html.

Maton, A., Hopkins, J., Johnson, S., LaHart, D., Warner, M. Q., & Wright, J. D. (1997). *Human biology and health.* Upper Saddle River, NJ: Prentice-Hall.

Meyers, J. (2010, August 26). *Ex-CIA official: Ground zero mosque 'symbol of victory' for extremists.* Newsmax. Retrieved August 27, 2010, from http://www.newsmax.com/Headline/scheuer-bin-laden-ground/2010/08/26/id/368530?s=al&promo_code=A9E5-1.

Military mountaineering. FM 3-97.61 (TC 90-6-1). (2002, August 26). Washington, DC: Department of the Army. Retrieved December 23, 2007, from http://www.globalsecurity.org/military/library/policy/army/fm/3-97-61/index.html.

Minox camera. (2008, June 2). CIA Museum. Retrieved December 21, 2009, from https://www.cia.gov/about-cia/cia-museum/cia-museum-tour/.

MONOCAM Digital Camera Adapter Kit. (2010). Morovision, Night Vision, Inc. Retrieved August 9, 2010, from http://www.morovision.com/morovision_monocam.html.

Moon phases. (2011).The University of Texas McDonald Observatory. Retrieved January 29, 2011, from http://stardate.org/nightsky/moon.

Morton, J. L. (2008). *Color vision for mice.* Color Matters. Retrieved March 3, 2008, from http://www.colormatters.com/vision_mice.html.

Morton, J. L. (2008). *How animals see color.* Color Matters. Retrieved March 3, 2008, from http://www.colormatters.com/kids/animals.html.

Motani, R. (2000, November 15). *Eyes of Ichthyosaurs.* Retrieved April 29, 2008, from http://www.ucmp.berkeley.edu/people/motani/ichthyo/eyes.html.

Muller, R. (1999, June 8). *Intes micro telescopes?* Retrieved February 28, 2011, from http://observers.org/tac.mailing.list/2001/June/0213.html.

Myth vs. Fact: Generation 4. (2010). Morovision Night Vision, Inc. Retrieved June 11, 2010, from http://www.morovision.com/terminology.htm#generations.

Nason, J. T. (2004, May). Conducting surveillance operations: How to get the most out of them. *FBI Law Enforcement Bulletin, Vol. 73,* No. 5. Washington, DC: United States Department of Justice, Federal Bureau of Investigation. Retrieved March 10, 2010, from http://www.fbi.gov/publications/leb/2004/may2004/may04leb.htm.

Near infrared technology: What is NIR Technology? (2009). Propper ECommerce, Inc. Retrieved October 1, 2009, from https://www.epropper.com/nir.php.

Nelson, T. (2002). *How to use telephoto lenses effectively?* Photography Happenings!! Retrieved January 20, 2008, from http://www.nelsontan.com/articles/telephoto/telephoto.htm.

Night vision. (2010). *Wikia, Inc.* Retrieved June 17, 2010, from http://psychology.wikia.com/wiki/Night_vision.

Nikon GP-1 GPS Unit. (2010). B & H Foto & Electronics Corp. Retrieved July 14, 2010, from http://www.bhphotovideo.com/c/product/580877-REG/Nikon_25396.html#features.

Objective lens diameter. (n.d.). Carl Zeiss Optical, Inc. Retrieved June 18, 2010, from http://www.zeiss.com/c1256bcf0020be5f/Contents-Frame/438738c15f135f968525756900519f4a.

Organized crime: It's in your neighborhood. Statistics. (2007, August 29). Government of Canada and the Canadian Association of the Chiefs of Police. Retrieved March 29, 2008, from http://www.organizedcrime.ca/statsfacts_e.asp.

Pappas, A. A., & Simon, J. M., Jr. (2007, April 14). *The intelligence community: 2001–2015. Daunting challenges, hard decisions.* Central Intelligence Agency. Retrieved December 28, 2008, from https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol46no1/article05.html.

Peach, D. (2002, July). *The atmosphere and observing–A guide to astronomical seeing.* ALPO Jupiter section. Retrieved January 6, 2008, from http://homepage.ntlworld.com/dpeach78/seeing2002.htm.

Photography (Basic), NAVEDTRA 14209, Intelligence photography. (1993, October). Nonresident Training Course. Pensacola, FL: Naval Education and Training, Professional Development and Technology Center (NETPDTC).

Photography using the Questar telescope. (n.d.). Questar Corporation. Retrieved January 6, 2008, from http://www.questarcorporation.com/QuestarPDF/PhotographywithaQuesC71.pdf.

Physics 1251. Science and technology of musical sound. (n.d.). University of North Texas. Retrieved September 30, 2010, from http://74.6.238.254/search/srpcache?ei=UTF-8&p=sound+diminishes+with+distance&fr=yfp-t-701&u=http://cc.bingj.com/cache.aspx?q=sound+diminishes+with+distance&d=4727474925930163&mkt=en-US&setlang=en-US&w=e7e6f5fc,5a82a40e&icp=1&.intl=us&sig=eegOSj_b8_4RfnmRNBskBw–.

Pike, J. *On foreign intelligence. Russian Federation federal law No. 5, Article 13, methods and means of intelligence gathering activity.* (1996, January 10). Intelligence Related Laws and Edicts. Retrieved March 8, 2008, from http://www.fas.org/irp/world/russia/docs/law_960110.htm.

Purkinje effect. (2010). *Dictionary.com, LLC.* Retrieved June 16, 2010, from http://www.reference.com/browse/purkinje+shift.

Quick release: Base and plate. (2009). BushHawk. Retrieved August 11, 2009, from http://www.bushhawk.com/_product_40948/Quick_Release_(Base_and_Plate).

Rains, N. (2002). *Understanding the DSLR magnification factor.* The Luminous Landscape Retrieved December 16, 2009, from http://www.luminous-landscape.com/tutorials/understanding-series/dslr-mag.shtml.

Ransom, H. H., & Pringle, R. W. (2009). *Intelligence.* BookRags.com. Retrieved July 7, 2010, from http://www.bookrags.com/eb/intelligence-eb/.

Ratty, B. D. (2004). *Digital photography: Crafting images.* Gearhart, OR: Media West Home Video.

Rayme, M. (2011, January 10). *Imagination: More important than knowledge?* Retrieved March 31, 2011, from http://www.suite101.com/content/imagination-more-important-than-knowledge-a330717.

Red adaptation goggles. (n.d.). Sciencestage.com. Retrieved March 13, 2011, from http://sciencestage.com/g/1815329/red-adaptation-goggles.html.

RegiStax: Stack astro images. (n.d.). SnapFiles. Retrieved April 6, 2010, from http://www.snapfiles.com/get/RegiStax.html.

Relative humidity (rh). (2006). Altalab, Inc. Retrieved June 15, 2010, from http://www.altalabinstrument.com/glossary.html#r.

Resnick, M. (2009, March 11). *Small cameras, big features.* Adorama Camera, Inc. Retrieved April 22, 2011, from http://www.adorama.com/alc/category/Compact-Digital-Cameras.

Rightwing extremism: Current economic and political climate fueling resurgence in radicalization and recruitment. (2009, April 7). Office of Intelligence and Analysis Assessment, U.S. Department of Homeland Security. Retrieved June 29, 2010, from http://www.docstoc.com/docs/5410658/DHS-Report-on-Right-Wing-Extremism.

Ritch, V. (2003). *Rural surveillance: A cop's guide to gathering evidence in remote areas.* Boulder, CO: Paladin Press.

Robot (camera): Robot Star. (2008, December 19). *Wikimedia Foundation, Inc.* Retrieved January 17, 2009, from http://en.wikipedia.org/wiki/Robot_camera.

Rockwell, K. (2008). *Lens sharpness.* KenRockwell.com. Retrieved September 27, 2008, from http://www.kenrockwell.com/tech/lens-sharpness.htm.

Rockwell, K. (2009). *Lighting.* KenRockwell.com. Retrieved December 25, 2010, from http://kenrockwell.com/tech/lighting.htm#.

Rosenthal, U., & Muller, E. R. (2007). *The evil of terrorism: Diagnosis and countermeasures.* Springfield, IL: Charles C Thomas.

Sapp, J. (2003, Spring). *How big is your exit pupil?* Retrieved April 20, 2009, from http://home.att.net/~jsstars/EP/ep.html.

Schmidt-Cassegrain telescopes (SCTs). (2008). Celestron.com. Retrieved December 17, 2010, from http://www.celestron.com/c3/support3/index.php?_m=knowledgebase&_a=viewarticle&kbarticleid=1638.

Scintillation. (2010). Morovision Night Vision, Inc. Retrieved March 5, 2010, from http://www.morovision.com/terminology.htm.

Secret photography. (2010, September 5). *Wikimedia Foundation, Inc.* Retrieved November 3, 2008, from http://en.wikipedia.org/wiki/Secret_photography.

Seeing. (1998–2008). KidsAstronomy. com. Retrieved January 9, 2008, from http://www.kidsastronomy.com/dictionary.htm#s.

Ship camouflage instructions, United States Navy, Ships–2, Second Revision, Bureau of Ships, June 1942. (2009). Historic Naval Ships Association. Retrieved February 28, 2011, from http://hnsa.org/doc/.

Siljander, R. (2008). *Introduction to business and industrial security and loss control.* Springfield, IL: Charles C Thomas.

Smith, C. M. (2001, September). *Detection of special operations forces using night vision devices, ORNL/TM-2001/172.* Oak Ridge, TN: Oak Ridge National Laboratory. Retrieved October 5, 2009, from http://www.ornl.gov/~webworks/cppr/y2001/rpt/111803.pdf.

Sniper training. FM 23-10. (1994, August 17). Fort Benning, GA: United States Army Infantry School. Retrieved June 19, 2010, from http://www.survivalmonkey.com/field_manuals_in_pdf.htm.

Special Forces, equipment: Kayaks. (2009). United States Army. Retrieved April 11, 2009, from http://www.goarmy.com/special_forces/equipment.jsp.

Special reconnaissance tactics, techniques, and procedures for special forces. FM 31-20-5. (1993, March 23). Washington, DC: Department of the Army.

State sponsors of terrorism. (2006, April 28). U.S. Secretary of State. Retrieved April 4, 2008, from http://www.state.gov/s/ct/rls/crt/2005/64337.htm.

Study manual LN324-91. (n.d.). School of the Americas (SOA). Retrieved March 29, 2008, from http://www.jar2.com/2/Intel/CIA/US%20Military%20STUDY%20MANUAL%20%20COUNTER%20INTELLIGENCE.htm.

Surveillance photography sop. (2002, April). *Forensic Science Communications, Vol. 4,* No. 2, 2002, April). Retrieved February 23, 2011, from http://www2.fbi.gov/hq/lab/fsc/backissu/april2002/swgitfield1.htm#guidelinesforsurveillancephoto.

Table of paints used by the USN during WWII (from: Instructions for painting and cementing vessels of the United States Navy 1943). (n.d.). Snyder & Short Enterprises. Retrieved February 28, 2011, from http://www.shipcamouflage.com/paint_formulas.htm.

Tele-Extender–Deluxe, Item #93643. (2010). Celestron. Retrieved June 6, 2010, from http://www.celestron.com/c3/product.php?CatID=50&ProdID=367.

Telescope. (2008). eNotes.com, Inc. Retrieved January 6, 2008, from http://www.enotes.com/earth-science/telescope.

Telescopes. (2003). *The new encyclopedia Britannica* (15th ed., Vol. 28). Chicago: Encyclopedia Britannica, Inc.

Telescopes with EQ1 & EQ2 mount. (n.d.). EfstonScience. Retrieved January 6, 2008, from http://www.escience.ca/resource/astronomy/manuals/NewStar_Dobsonian.pdf.

Ten top telescope eyepiece questions. (2009). OpticsPlanet, Inc. Retrieved August 5, 2009, from http://www.opticsplanet.net/telescope-eyepiece-questions.html.

The impact of new technology. (2005). HighBeam Research, LLC. Retrieved May 9, 2010, from http://www.infoplease.com/ce6/ent/A0860372.html.

The importance of sight at night. (2010). Morovision Night Vision, Inc. Retrieved June 11, 2010, from http://www.morovision.com/nv_case_studies_p2.htm.

The incredible machine. (1994). Washington, DC, National Geographic Book Service.

The official WSRS rating system for clarifying water-tightness. (2007). ROC Gear, Inc. Retrieved May 2, 2009, from http://www.thewaterproofstore.com/wsrs.html.

The water cycle: Condensation. (2008, August 13). U.S. Geological Survey. Retrieved September 22, 2008, from http://ga.water.usgs.gov/edu/watercyclecondensation.html.

Thomas A. Edison quotes. (2010). BrainyQuote. Retrieved December 13, 2010, from http://www.brainyquote.com/quotes/quotes/t/thomasaed132683.html.

Torae, John (n.d.). *Focal length and focal ratio.* Telescope Science. Retrieved March 10, 2011, from http://telescopescience.com/focal_length.html.

Towle, A. (1999). *Modern biology.* Austin, TX: Holt, Rinehart and Winston.

Tretheway, S., & Katz, T. (1998). *Motorcycle gangs or motorcycle mafia?* National Alliance of Gang Investigators' Associations. Retrieved April 23, 2008, from http://www.nagia.org/Gang%20Articles/Motorcycle%20Gangs.htm.

Turberville, J. (2003). *Afocal coupling: AKA digiscoping.* Retrieved February 19, 2010, from http://www.jayandwanda.com/digiscope/vignette/afocalcouple.html.

12-40x60mm spotting scope soft side case. (2009). Leupold & Stevens, Inc. Retrieved August 24, 2009, from http://www.leupold.com/tactical/products/mounting-systems-and-accessories/binocularsspotting-scope-accessories/12-40x60mm-spotting-scope-soft-case/.

24-7 Recon R/T Scope Kit, 10x50 tactical scope. (2011). Morovision Night Vision, Inc. Retrieved February 24, 2011, from http://www.morovision.com/eoplatforms/24-7-recon.htm.

2005 National Gang Threat Assessment. (2005). National Alliance of Gang Investigators Associations. Department of Justice, Bureau of Justice Assistance in partnership with the Federal Bureau of Investigation; National Drug Intelligence Center; Bureau of Alcohol, Tobacco, Firearms and Explosives. Retrieved August 6, 2010, from www.ojp.usdoj.gov/BJA/what/2005_threat_assesment.pd.

US Army survival manual. FM 21-76. (1970, October). Washington, DC: Department of the Army.

U.S. faces "Americanization" of terror threat. (2010, September 10). Reuters Limited. Yahoo! Inc. Retrieved September 19, 2010, from http://news.yahoo.com/s/nm/us_usa_qaeda.

Utility: Sized to fit all trucks, lightweight camper. (2005). Six-Pac Campers. Retrieved October 24, 2009, from http://www.six-pac.com/camper_utility.htm.

Utz, P. (n.d.). *The 10 most important things to know about tripods*. Retrieved February 1, 2009, from http://videoexpert.home.att.net/artic1/225atrip.htm.

Violent gangs. (n.d.). FBI.gov. U.S. Department of Justice, Federal Bureau of Investigation. Retrieved August 5, 2010, from http://www.fbi.gov/hq/cid/ngic/violent_gangs.htm.

Vision requirements. (n.d.). Naval Special Warfare Command. Retrieved February 24, 2011, from http://www.seal.navy.mil/seal/vision.aspx.

War-time clandestine photographer Taconis subject of paper at Dutch conference: Images helped Dutch Canadian grasp experience of parents. (2005, April 7). goDutch.com. Vanderheide Publishing Co. Ltd. Retrieved April 1, 2010, from http://www.godutch.com/newspaper/index.php?id=729.

What is a "Cutter"? (2008, December 9). United States Coast Guard, Department of Homeland Security. Retrieved November 19, 2009, from http://www.uscg.mil/history/faqs/Designations.asp.

What is a digital SLR camera? (2009). Digital SLR Guide. Rtrieved February 23, 2009, from http://www.digital-slr-guide.com/what-is-a-digital-slr.html.

What is dry ice? (2005, October). New York State Department of Health. Retrieved March 19, 2011, from http://www.health.state.ny.us/environmental/indoors/food_safety/dry_ice.htm.

What is low vision? (n.d.). Michigan College of Optometry, Ferris State University. Retrieved June 16, 2010, from http://www.ferris.edu/colleges/michopt/link_desc.cfm?LinkID=101.

What is the focal ratio? How is it related to the f-stop? (2008). Celestron. Retrieved February 24, 2011, from http://www.celestron.com/c3/support3/index.php?_m=knowledgebase&_a=viewarticle&nav=0&kbarticleid=1650.

What's the difference between thermal imaging and night vision? (2009). FLIR Systems, Inc. Retrieved June 19, 2010, from http://www.flir.com/cvs/americas/en/content/?id=9612.

Why is night vision green? (2010). Morovision Night Vision, Inc. Retrieved June 10, 2010, from http://www.morovision.com/faqs.htm.

Workhorse. (n.d.). *The American heritage dictionary of the English language* (4th ed.). Retrieved July 25, 2010, from Dictionary.com website: http://dictionary.reference.com/browse/workhorse.

Zerbe, C. (n.d.). *Video astronomy*. The American Lunar Society. Retrieved April 5, 2010, from http://www.amlunsoc.org/video.htm

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